State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
Division of Engineering

SAELTZER DAM FISH PASSAGE PROJECT

PROPOSED UPSTREAM DAM SITE

GEOLOGIC FEASIBILITY REPORT

PROJECT GEOLOGY SECTION
REPORT NO. 94-00-09

DECEMBER 1997

STATE OF CALIFORNIA
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DIVISION OF ENGINEERING

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This report and associated drawings were prepared under my direction as the professional geologist in direct responsible charge of the work, in accordance with the provision of the Geologist and Geophysicists Act of the State of California.

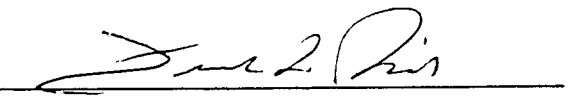

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TABLE OF CONTENTS

TABLES

FIGURES AND PLATES

APPENDICES

INTRODUCTION

The Project Geology Section performed geologic feasibility activities for a proposed new dam as part of the Saeltzer Dam Fish Passage Project. This project area is located in Shasta County, approximately 5.75 miles west of State Highway 273, between Redding and Anderson, California (Figure 1). The proposed dam is to be located on Clear Creek, approximately 2,200 feet upstream, west-northwest of the existing Saeltzer Dam. Approximate California Coordinates for the center of this site are N 2,063,900; E 6,429,250. It is our understanding that other dam alignments are also being considered. A pipeline is also proposed to convey water from the new dam to the existing irrigation canal at the existing Saeltzer Dam.

The geologic investigation was performed in response to verbal requests from Kevin Dossey of the Northern District over several meetings between July and October, 1997. To help reduce total costs, a formal proposed geologic exploration program was not prepared. Prior to working upstream of the existing dam, Frank Glick completed a geologic assessment of the existing Saeltzer Dam, which was forwarded to Northern District's Bill Mendenhall in a Memorandum dated July 11, 1997.

The geologic feasibility exploration program for the project consisted of four components: 1) excavation and logging of test pits, 2) a seismic refraction survey of the proposed dam axis and surrounding area, 3) drilling and logging exploration borings into bedrock, and 4) field mapping.

GEOLOGIC EXPLORATION

Test Pits

Five test pits were excavated by U.S. Bureau of Land Management personnel and equipment to depths ranging from 10.0 to 14.0 feet (See Plate 1 for locations). A Caterpillar 416B front-end loader/backhoe was used to excavate the five test pits to refusal or maximum reach of the equipment. Test pits TH#1, TH#2, and TH#3 were excavated on August 6, 1997, roughly along the axis of the proposed dam. These test pits were logged and photographed by Frank Glick (Photos 1 through 5). Two additional test pits (TH#4 and TH#5) were excavated on November 3, 1997. They were logged, sampled, and photographed by Brent Lamkin. All test pits were backfilled with spoil from the excavations.

Test pits TH#1, TH#2, and TH#3 were located in the Recent deposits of Clear Creek, near the axis of the proposed dam. From zero to about one-foot below ground surface (bgs), the lithology consisted of a pavement of poorly graded, subangular to rounded, fine to coarse gravel and hard to very hard, subrounded to rounded volcanic, granitic, and metamorphic cobbles up to 0.9 feet. Below one foot bgs, the test pits indicated loose to slightly compact, poorly graded sand with gravel and cobbles [$(SP)_{g,c}$] to poorly graded gravel with sand and cobbles [$(GP)_{s,c}$] with a possible zone of dense cobbles and gravel at eight to ten feet bgs. The three dam axis pits exhibited saturated conditions beginning at five to seven feet bgs. Bedrock was not encountered in the three dam axis test pits, although the backhoe operator encountered hard materials at 10.0' in TH#3, which he thought could possibly be bedrock. Test pits TH#2 and TH#3 were advanced to 10.0 feet in depth, while TH#1 was excavated to 8.0.

Two additional test pits (TH#4 and TH#5) were excavated downstream of the proposed dam. Samples were collected from two elevations within each of these pits for use in sediment transport modeling. These soil samples were delivered to DWR's Northern District Office for analysis and final disposition. Geologic logs for Test Pits TH#4 and TH#5 are included in Appendix A; no formal logs were prepared for TH#1, 2, and 3.

Test pit TH#4 was located in older stream terrace deposits and consisted of approximately one foot of silty sand [SM] overlying three feet of poorly graded sand with gravel and cobbles

[$(SP)_{g,c}$] deposited above poorly graded gravel with sand and cobbles [$(GP)_{s,c}$]. Sporadic and small, saturated lenses were encountered at 8.0 feet bgs. At 12.2 feet bgs saturated conditions were encountered, with water rushing into the excavation and stabilizing at 11.0 feet bgs. Soil samples were collected at 3.5-5.5 feet (Sample A) and at 10.0-11.0 feet (Sample B) bgs. Test pit TH#4 was excavated to a depth of 12.5 feet bgs, where backhoe bucket refusal was encountered in hard, strong cobbles.

Test pit TH#5 was also located in older stream terrace deposits. The first four and one-half feet of TH#5 consisted of interbedded silty sands [SM] and poorly graded sand with gravel [$(SP)_g$]. From 4.5 to 14.0 feet bgs, the excavation encountered poorly graded gravel with sand and cobbles [$(GP)_{s,c}$]. Saturated conditions were encountered at 12.0 feet, with water stabilizing at 10.5 feet bgs in the excavation. Soil samples were collected at 4.5-5.5 feet (Sample A) and at 8.5-10.0 feet (Sample B) bgs. Test pit TH#5 was excavated to a depth of 14.0 feet bgs, the depth limit of the equipment.

Seismic Refraction Survey

In order to characterize a larger area of the subsurface at and surrounding the proposed dam site, a seismic refraction survey was conducted between September 2 and 9, 1997. The seismic refraction survey was directed by Robert Conover, of the Project Geology Section. Mr. Conover was assisted by Farhad Nasirian, of Project Geology, and Northern District personnel. Thirteen seismic refraction lines varying from 75 to 270 feet in length were run (Plate 1). The lines were laid out along the proposed dam axis, upstream and downstream of the axis, and along the proposed pipeline alignment.

The survey was performed with a Bison 7000 seismograph typically using 24 geophones on five to ten foot spacings; lines CCSL-2 and CCSL-10 were shorter than usual and only incorporated 10 and 18 geophones, respectively. The energy source for the study was a 12-pound hammer and plate, with "shot points" located at five and 15 feet from the ends of the line (except CCSL-13, where the shot points were off-set 10 and 25 feet, respectively) and at the center of the line. The seismic data was then reduced and analyzed by Robert Conover using the computer program Refract (version 3.13). From the analysis of the seismic data, velocities for the

subsurface were produced for two distinct seismic layers. Processed seismic data is located in Appendix B.

The upper or surface layer (V_1) shows an average in-situ velocity ranging from 735 to 1,430 feet per second (fps). These velocities are consistent with known refraction velocities for unsaturated alluvial materials, such as those seen in test pits TH#1 through TH#5. The top of the second or lower seismic layer (V_2) layer ranges from 2.5 (CCSL-2, elevation 557.6') to 20.5 (CCSL-13, elevation 576.3') feet bgs with an average in-situ seismic velocity range of 11,162 to 24,700 fps. The velocities for seismic layer V_2 are consistent with the velocities for crystalline rock, such as the metamorphic bedrock encountered in the borings and described in the next section.

It should be noted that the accuracy of seismic velocity layer depths is subject to many factors, including the geophone spacing. For this site, the seismic refractor elevations are +/- half the distance between each geophone of a given seismic line; therefore the refractor elevations are within 2.5 to 5.0 feet of the elevations indicated. Also, it should be noted that seismic refractors are not always consistent with geologic contacts between materials.

Of particular significance to the proposed dam location are seismic lines CCSL-1, CCSL-2, and CCSL-10, which are parallel to and approximately 18 to 50 feet downstream of the proposed dam axis. Other significant seismic lines are CCSL-4, located subparallel to and approximately 75 to 130 feet downstream of the proposed dam axis, and CCSL-11, which is parallel to the north side of Clear Creek and normal to the dam axis; CCSL-11 runs north-northeast from about 20 feet downstream of the proposed dam for 168 feet. These five seismic lines were laid out to characterize the subsurface at and in the immediate vicinity of the proposed dam site. Seismic data for the axis of the proposed dam indicated apparent bedrock depths ranging from about 2.7 feet bgs (elevation 554.9') at geophone 10 on line CCSL-2, to about 11.5 feet bgs (elevation 554.2') at geophone 2 on CCSL-10. Data from CCSL-1 and CCSL-2 show that the apparent bedrock dips slightly to the northwest along the axis of the proposed dam. However, line CCSL-10 indicates that bedrock dips sharply to the southeast from elevation 560.1' (phone 18) to 553.8' (phone 1). Cross Section A-A (Plate 2) shows the seismic velocity contacts between alluvium and apparent bedrock parallel to and near the proposed dam axis. Seismic line

CCSL-4 also shows that the top of bedrock dips to the south (from elevation 556.1' at phone 24 to elevation 550.1' at phone 1) contradicting the data from lines CCSL-1 and CCSL-2. Data from CCSL-11, running normal to the proposed dam axis, showed a fairly flat bedrock surface ranging from elevation 552.9' to 553.2', with approximately 11.1 to 15.0 feet of alluvial cover. In some cases, the depth of the seismic refractor does not correlate well with the drill hole information, described in the next section.

Eight other seismic lines were run, one upstream of the proposed dam site (CCSL-3) and seven downstream. Upstream, seismic data indicated that the top of apparent bedrock dips northwest ranging in depth from about 6.2 feet bgs (elevation 559.6') at phone 3 to about 13.9 feet bgs (elevation 554.3') at phone 22. The downstream seismic lines showed the top of bedrock elevations ranging from about 544.0' at phone 1 on CCSL-9 (20.2 feet bgs) to about 564.0' at phone 24 on line CCSL-13 (14.1 feet bgs). Generally, the depth to apparent bedrock ranged from about 7.6 feet bgs (phone 6, CCSL-5) to 20.7 feet bgs (phone 1, CCSL-13).

Seismic line CCSL-12 data was not included in this report as a conflict in the data could not be resolved using the Refract software.

Exploration Drilling

Twelve exploratory test borings were drilled as part of the subsurface exploration program. Boring locations were laid out in the field on October 28, 1997, by Kevin Dossey, Brent Lamkin, and Frank Glick. Before drilling could commence, environmental clearances were secured to allow work within the riparian zone of the proposed dam site. In an Office Memo from Harry Rectenwald to Kevin Dossey dated September 26, 1997, the Department of Fish and Game provided a waiver from the requirements of a Stream or Lake Alteration (1601) Agreement to conduct geologic exploration along Clear Creek.

The purpose of the exploration borings was to confirm seismic refraction data and interpretations, determine the depth to the top of bedrock, and obtain samples of in-situ bedrock in order to describe its engineering properties. Drilling was conducted by P.C. Exploration, Inc., of Roseville, California, using a Mobile B-53 truck-mounted drill rig (Photo 7). Exploration borings were advanced using hollow-stem augers and rotary wash drilling with an HQ size wire-

line core barrel and a diamond-impregnated drill bit. All borings were initially augered with 8.0-inch o.d. hollow-stem flight augers to a depth of refusal. Soils were logged wholly from cuttings and drill rig response by Brent Lamkin, Associate Engineering Geologist. Eight of the twelve borings were continued with core drilling methods eight to ten feet beyond auger refusal for the recovery of in-situ bedrock. At the completion of each boring, the open hole was backfilled with bentonite-cement grout using a tremie line, or with auger cuttings. Geologic drill logs are included in Appendix A.

Three areas of the project site were investigated using exploratory borings: 1) upstream of the proposed dam, 2) at and in the immediate vicinity of the proposed dam axis, and 3) downstream of the dam. Ten of the borings were located on stream terrace deposits and two were located on Recent stream channel deposits within the boundaries of Clear Creek. The Recent stream deposits encountered in borings CCB-1 and CCB-2 consisted of 17 to 18 feet of loose to compact, poorly graded sand with gravel and cobbles [$(SP)_{g,c}$] with a maximum dimension of at least 10 inches. Nearby test pits TH#1-3 indicate that the stream deposits may be closer to a poorly graded gravel with sand and cobbles, as cobbles and some coarse gravel may not show in the auger cuttings. The poorly sorted sand with gravel and cobbles is overlain by a 1.0 to 1.5-foot thick pavement of poorly graded gravel with sand, cobbles, and occasional small boulders with a 1.3-foot maximum dimension. Borings located on stream terraces encountered silty sands, silty sands with gravel, silty sands with gravel and cobbles, poorly graded sands, poorly graded sands with gravel, poorly graded sands with gravel and cobbles, poorly graded gravels with sand and cobbles, and sandy lean clay. These stream terrace deposits ranged from 11 to 20 feet thick. Coarse fractions of the stream and stream terrace deposits consisted of up to 80 percent hard to very hard, subangular to rounded, volcanic, granitic, and metamorphic gravel up to 3.0-inches, and up to 20 percent (total volume) hard to very hard, subangular to rounded, volcanic, granitic, and metamorphic cobbles (with occasional small boulders) up to 1.3 feet in maximum dimension.

All borings advanced into bedrock appear to have encountered the Devonian age Copley Greenstone, as mapped and described by Hollister and Evans (1965) in the adjacent Redding Quadrangle. Bedrock was logged as greenstone (possibly a metamorphosed basalt) with

mylonitic banding. The greenstone is green-gray, moderately weathered to fresh, hard to very hard, and moderately strong to very strong; it is intensely to closely fractured, with fractures dipping 15-80° (predominantly 40-60°), and the fracture faces coated with up to 0.2-inches of any combination of calcium carbonate, pyrite, and/or iron oxide (Photo 8). The greenstone is aphanitic with abundant pyrite mineralization and occasional minor shears of up to 0.2-feet thick. Round to oval, hard, quartz infillings up to 0.4-inches in diameter were observed in greenstone core from borings CCB-3, CCB-6, and CCB-10; the infillings may be relict amygdules. Of the eight borings cored, the mylonite banding content ranged from 0 to 100 percent of the recovered core, with an overall average of about 42 percent. The mylonite banding within the greenstone is gray to black, moderately to slightly weathered, moderately hard to hard, and weak to strong; it is intensely to closely fractured, with fractures dipping 20-80° (predominantly 30-45°), and the fracture faces are coated with a combination of calcium carbonate, pyrite, and/or iron oxide up to 0.1-inch thick. The mylonite is also aphanitic, has abundant pyrite mineralization, and exhibits weak to strong foliation dipping from 10 to 40°. The mylonite exhibits some properties of and resembles shale or meta-shale, including an occasional "scum" of black, carbonaceous material detected in recirculated drilling fluids. Overall rock quality, as measured using the Rock Quality Designation method (RQD), ranged from zero (very poor) at CCB-1 and CCB-7A to 40 percent (poor) at CCB-13, with an overall average of 12 percent, or very poor.

One boring, CCB-3, was drilled upstream of the proposed dam axis. Boring CCB-3 was located along seismic line CCSL-3, roughly between phones 10 and 11. The boring was augered to a depth of 20.0 feet, then continued with diamond-bit coring to 30.0 feet bgs. Bedrock was encountered at 20.0 feet bgs (elevation 547.0'). At and in the immediate vicinity of the proposed dam axis, four borings (CCB-1, CCB-2, CCB-10, and CCB-11) were drilled from 12.5 to 29.0 feet bgs. The borings showed that bedrock ranged from 15.6 to 20.0 feet below the surface, or from elevation 550.5' (CCB-10) to 542.2' (CCB-1); this also indicates that the bedrock surface appears to dip southeast along the axis of the proposed dam. Cross Section A-A (Plate 2) shows the lithology along the proposed dam axis. Downstream of the proposed dam seven borings encountered bedrock from 11.0 to 19.5 feet bgs, with the top of bedrock elevation ranging from 544.9' (CCB-9) to 558.0' (CCB-13). The bedrock elevations indicate that the stream terrace

deposits downstream of the proposed dam are in a trough that dips sharply northwest (upstream) between CCB-13 and CCB-7A, flattens out between CCB-7A and CCB-6, and then climbs northeast to CCB-6A and outcrops about 150 feet to the northeast, along the opposite bank of Clear Creek at approximately elevation 558'. Cross Section B-B (Plate 3) shows boring data and the geology through Clear Creek, downstream of the proposed dam.

Geologic Mapping

Rock outcrops were mapped in the vicinity of the proposed upstream dam site during the conduct of other geologic exploration. Bedrock was noted at five locations within the map area (Plate 1). Rock types resembled the greenstone and mylonite banding described in the geologic boring logs, with the exception that the rock was moderately to slightly weathered. Greenstone was mapped at three locations: Outcrop #1 in the middle of the active channel of Clear Creek (Photo 6) between CCB-2 and CCB-10 (approximately N 2,062,980; E 6,428,950) at approximate elevation 559'; Outcrop #2 along the northeast bank of Clear Creek, approximately 160 feet east of CCB-6A (N 2,063,680; E 6,430,010) at approximate elevation 558'; and Outcrop #3 along a road-cut about 380 feet east-northeast of boring CCB-13 (N 2,063,120; E 6,430,575) at approximately 576' in elevation. Mylonite banding was mapped in outcrop at two locations: Outcrop #4 at a break in slope approximately 320 feet south of CCB-3 (N 2,062,980; E 6,428,950) at about 590' in elevation, and Outcrop #5 along a break in slope about 100 feet southeast of CCB-1 (N 2,063,650; E 6,429,280) at approximately 568' in elevation. Reconnaissance mapping of road cuts along the north side of Clear Creek, upstream of the existing Saeltzer Dam, showed that outcrops resembled the greenstone and mylonite logged in the geologic core and observed in out-crop at the project site. The outcrops are depicted on Plate 1, and are included in Cross Sections A-A and B-B.

An area approximately 1.25 miles upstream of the existing dam was examined in addition to the proposed project site. Rock was noted in outcrop along the north edge of Clear Creek, about three-quarters of a mile upstream of the proposed dam. At first the rock looked like interbedded shale and graywacke, with the apparent sandstone forming resistant ridges around the softer shale-like material. Upon closer examination, the moderately weathered rock was identified

as a brown-gray to olive, very fine grained, metavolcanic rock interlayered with black, mylonitic zones. The metavolcanic rock is moderately to slightly weathered, hard, strong, closely to moderately fractured, and massive; it appears to be made up of predominantly euhedral quartz and possibly sodic plagioclase. The mylonite zones resemble argillite; it is moderately to slightly weathered, weak to moderately hard, moderately strong, internally sheared (slickensided) in various directions, closely fractured, and exhibits little to no foliation. The rock may possibly be a metamorphosed tuff with zones that have been deformed plastically (mylonite). A sample of the bedrock was collected from a very shallow backhoe excavation (2.0-2.5 feet deep), unofficially designated test pit TH#6. As bedrock was exposed at ground surface and just below the surface of Clear Creek, we did not include this rock description in the test pit section of this report.

FINDINGS AND RECOMMENDATIONS

Findings

It appears to be geologically feasible to build a dam in the area investigated. The surface and subsurface of the project area was characterized by using a combination of exploration methods: excavated test pits, seismic refraction surveys, auger and diamond core borings, and field mapping. These exploration methods were employed at three distinct areas of the project: upstream, downstream, and at the proposed dam site. At all three of these areas the geology was fairly consistent with Recent alluvial stream terrace and stream channel deposits overlying metamorphic greenstone.

The greenstone bedrock is generally hard and strong, and would make a good foundation. Conversely, the alluvium is loose to compact, and generally consists of subrounded, poorly graded sands with gravel and cobbles, and poorly graded gravel with sand and cobbles. The alluvium covering the project area contains no cohesive soil fraction. These coarse, uncohesive materials would be difficult to consolidate, and would make a poor foundation.

After determining the soil and rock types within the project area, the other primary aim of the exploration was to determine the depth to the top of bedrock. Both drill holes and seismic refraction was used to determine the depth to the top of bedrock. However, in the three primary areas studied, overall correlation of seismic refraction data with boring data was generally not achieved. Table 1 compares the relative bedrock depths and elevations determined by boring and seismic refraction methods.

Upstream of the proposed dam axis, greenstone bedrock was encountered at 20 feet bgs, or elevation 547.0'. However, data for seismic refraction line CCSL-3 indicates an apparent bedrock depth of 9.5 feet bgs, or elevation 557.6 (a difference of 10.5 feet). Seismic line CCSL-3 also indicates that the bedrock surface dips southeast at that location.

In the vicinity of the dam axis, borings and field mapping indicate three possible interpretations for the bedrock-alluvium contact. The three alternatives are presented on Cross Section A-A as Alternative 1, 2, and 3.

Alternative 1 shows the bedrock surface at elevation 550.5' in CCB-10 rising to elevation 559.0' at Outcrop #1, then dipping southeast to CCB-2 at elevation 545.3' and CCB-1 at 542.2', then rising steeply to elevation 568.0' at Outcrop #5. This alternative seems the least likely from the standpoint of a typical migrating stream. As Clear Creek appears to be migrating northward at the proposed dam site, it would be very unusual to encounter an uneroded pinnacle of bedrock in an active stream channel. Nevertheless, Outcrop #1 appears to be in-situ bedrock, and can not be ignored in interpreting the likely contact between bedrock and alluvium. In the case of Alternative 1, the seismic refraction data does not correlate with the boring data (Table 1 and Plate 2).

Alternative 2, for Cross Section A-A, assumes that the apparent bedrock within the channel of Clear Creek is a large block or boulder. If the greenstone block is considered part of the alluvium instead of bedrock, the boring data for CCB-1, 2 , and 10 show a consistent dip to the southeast for the top of bedrock. The bedrock surface expression in Alternative 2 corresponds well with typical stream geology. Again, the boring and seismic refraction data do not correlate for this alternative interpretation of geology along the dam axis.

The most reasonable alternative explanation for Cross Section A-A is Alternative 3. This alternative assumes the top of bedrock at boring CCB-10 to be at elevation 556.1', between poorly graded gravel with sand and cobbles, and a clayey sand with gravel (Appendix B). In this alternative, the clayey sand with gravel is assumed to be decomposed greenstone bedrock. The Alternative 3 interpretation allows for correlation between data from boring CCB-10 and seismic line CCSL-10. It is also more realistic to present a small bedrock high within an active stream channel such as in this alternative, versus the large bedrock high in Alternative 1. While the seismic data for CCSL-1 and CCSL-2 still do not correlate with the boring data (Table 1) in this alternative, it is a little closer at CCB-2/CCSL-2.

Boring and field mapping data show that alluvial cover thickness varies from zero to 19 feet along the axis of the proposed dam for Cross Section A-A Alternatives 1 and 3; Cross Section A-A Alternative 2 indicates about seven to 19 feet of alluvium overlies bedrock. The variable depths to bedrock indicated in Alternatives 1 and 3 show that the bedrock surface is fairly uneven, and is probably controlled by the mechanical weathering of the intensely to closely

fractured bedrock. Seismic data from lines parallel to the proposed dam axis vary in degree, and geometry; CCSL-1 and CCSL-2 exhibit a gentle northwesterly dip, while CCSL-4 shows bedrock dipping sharply to the south. On the north side of Clear Creek, seismic line CCSL-10 indicates that bedrock dips sharply to the southeast. The bedrock surface is fairly flat running parallel to the north bank of Clear Creek, roughly normal to the axis of the proposed dam. Seismic data from around the proposed dam site indicates about 2.7 to 15.0 feet of alluvial cover over bedrock.

The discrepancy in bedrock surface depths (10.6 to 13.0 feet) and geometry between the seismic and boring data cannot be completely resolved with the existing data. Both sets of data show that bedrock dips northwest on the north side of Clear Creek. However, the data does not correlate between Outcrop #1 and Outcrop #5, which includes borings CCB-1 and CCB-2, and seismic lines CCSL-1 and CCSL-2. It is possible that a dense layer of hard to very hard gravels and cobbles may have exhibited seismic velocities consistent with the underlying bedrock; even if the layer were relatively thin, it would mask lower velocity materials beneath the cobble lens, but above the bedrock surface. As the boring and mapping data are direct evidence of the subsurface, it shall be used at and around the proposed dam site.

Geologic Cross Section A-A (Plate 2) indicates that the ancestral Clear Creek channel has been filled with alluvial materials as the active stream migrates north. Borings CCB-1 and CCB-2 are located in a probable bedrock trough created by the ancestral Clear Creek. The alluvium encountered in CCB-1 and CCB-2 is probably a point-bar deposit, as evidenced by the coarseness of the material and its physical location at a sharp bend within Clear Creek.

Downstream of the proposed dam site, a second geologic cross section has been drawn to depict the subsurface. Cross Section B-B (Plate 3) runs northeasterly from CCB-6 to Outcrop #2, and shows both seismic refraction and boring information. The cross section shows a correlation between the seismic refraction and boring data where they overlap.

At Section B-B, the bedrock surface dips to the southwest in the boring data, but has a northeasterly dip using the seismic data. This apparent conflict can be resolved by interpolating the probable bedrock surface to a probable outcrop elevation of 582.0' at a steep break in slope approximately 100 feet to the southwest of CCSL-6, phone 1. This interpretation indicates that

alluvium fills a northwest trending trough at this location across the existing stream. From zero to at least 14.0 to 19.5 feet of alluvial deposits overlie the bedrock along Cross Section B-B.

Downstream of Cross Section B-B, seismic data generally correlates with the boring logs. Both sets of data show that bedrock dips steeply from CCB-13; the data differ, starting at CCB-7A, as to the top of bedrock geometry. The borings show bedrock flattening from CCB-7A to CCB-5. Seismic refraction data shows the bedrock dipping northwest to a low beneath CCB-9, then rising to elevation 557.8' at CCB-5, forming a trough that runs perpendicular to the current stream course. As boring CCB-5 did not encounter bedrock by elevation 551.8', we believe at that location the seismic apparent bedrock elevation of 557.8' should be disregarded as a possible lens of dense cobbles and gravel.

The seismic refraction depth of alluvial cover downstream of the proposed dam ranges from about 7.6 (CCSL-5, phone 6) to 20.7 (CCSL-13, phone 1) feet bgs. In comparison, the depth to bedrock recorded during drilling ranged from 11.0 (CCB-13) to 19.5 (CCB-6) feet bgs. Overall elevation, as observed in borings and bedrock outcrops, for the top of bedrock downstream of the proposed dam ranged from a high of 558.0 (CCB-13 and Outcrop #3) to a low of 544.9 (CCB-9), but generally confined between 542.0 and 550.0'. Again, the greenstone bedrock displays an irregular, predominantly slightly weathered surface; the surface geometry is probably the result of

mechanical weathering by ancestral Clear Creek, controlled by fracture density and undetermined joint sets.

Overall, the project area is covered by up to 20.0 feet of loose to compact, alluvial sands, gravels, and cobbles that would require removal beneath the foot print of the proposed dam. Plate 4 shows the estimated depth of bedrock, as contours, within the study area. All of the contours are inferred depths, except at outcrops and where encountered in borings. The bedrock depths were estimated using boring and mapping data; seismic refraction data was not used in this map, as it did not correspond with the boring data. Generally, bedrock elevation ranges between 542.0' and 550.5' for most of the project area. The bedrock surface appears to follow the course of the existing stream, exhibiting scoured troughs along Cross Sections A-A and B-B.

Recommendations

A stream sediment transport model should be run to show the erodibility of the alluvial soils and their response to a change in stream gradient between the existing dam and the proposed dam. We believe it is likely that the cohesionless sands and gravels of the project site would be subject to headward erosion and sloughing as a result of building a new dam, and the removal of the existing dam. However, quantification of the probable erosion cannot be determined without modeling.

Assuming that sediment transport modeling determines that the change in gradient will not cause excessive erosion, other factors should be considered in the design of the proposed dam. The recommendations listed below should be taken into consideration for cost estimates and design. The following recommendations are based upon the information gathered during this investigation, and summarized in the above pages:

1. Additional subsurface drilling and trenching should be conducted to better define bedrock characteristics, such as depth, weathering, strength, and groutability at and around the final dam location.
2. For construction, alluvial materials should be stripped to bedrock within the foot print of the dam.
3. All-weather access roads to both banks of the project site should be constructed.
4. Alluvial soils on-site should be tested for suitability as construction material.
5. Dewatering estimates should be made.
6. A fault and seismicity study should be conducted to determine the seismic history and possible seismic hazards of the site.

It should be emphasized that this is only a reconnaissance level geologic investigation. A much more detailed geologic investigation would be required for the design of a new dam for this project.

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TABLES

TABLE 1

RELATIVE BEDROCK DEPTHS AND ELEVATIONS

BORING #	LOCATION	GROUND SURFACE ELEVATION	BORING BEDROCK DEPTH	SEISMIC BEDROCK DEPTH	APPARENT DEPTH DIFFER.	BORING BEDROCK ELEVATION	SEISMIC BEDROCK ELEVATION
CCB-1	CCSL-1 ph. 8	561.2'	19.0'	7.1' (avg.)	11.9'	542.2'	554.1'
CCB-2	CCSL-2 10' w of ph. 1	564.3'	19.0'	8.4'	10.6'	545.3'	555.9'
CCB-3	CCSL-3 ph. 10-11	567.0'	20.0'	9.5'	10.5'	547.0'	557.6'
CCB-5	CCSL-5 ph. 12	566.8'	>15'	9.1'	>5.9'	<551.8'	557.8'
CCB-6	CCSL-8 ph. 1/ CCSL-6 ph. 13	565.7'	19.5'	16.7/15.9'[1]	2.9/3.6' [1] *	546.2'	549.1/549.7'[1]
CCB-6A	CCSL-6 15' n ph. 24	565.0'	16.0'	18.6'	2.6' *	549.0'	546.9'
CCB-7	CCSL-7 ph. 22-23	564.0'	>14'	15.3' (avg.)	1.3'	<550.0'	548.9'
CCB-7A	CCSL-7 ph. 9-10	564.5'	19.5'/15.5' [2]	10.9' (avg.)	8.6/4.6'	545.0/549.0'	553.6'
CCB-9	CCSL-9 ph. 4-5	563.9'	19.0'	19.1'	0.1' *	544.9'	544.9'
CCB-10	CCSL-10 ph. 6	566.1'	15.6'	10.4'	5.2'	550.5'	555.7'
CCB-11	CCSL-11 ph. 18	565.2'	>12'	12.3'	>0.3'	<553.2'	552.9'
CCB-13	CCSL-13 5' w ph. 13	569.0'	11.0'	8.5'	3.5' *	558.0'	560.5'

Notes: 1. Seismic refractor velocities for both CCSL-8, phone 1 and CCSL-6, phone 13 included.

2. CCB-7A drilled twice, four feet apart; data from both borings is included.

* The difference between the seismic and boring depths to bedrock fall within the seismic refraction error factor of +/- one-half the geophone spacing.

FIGURES AND PLATES

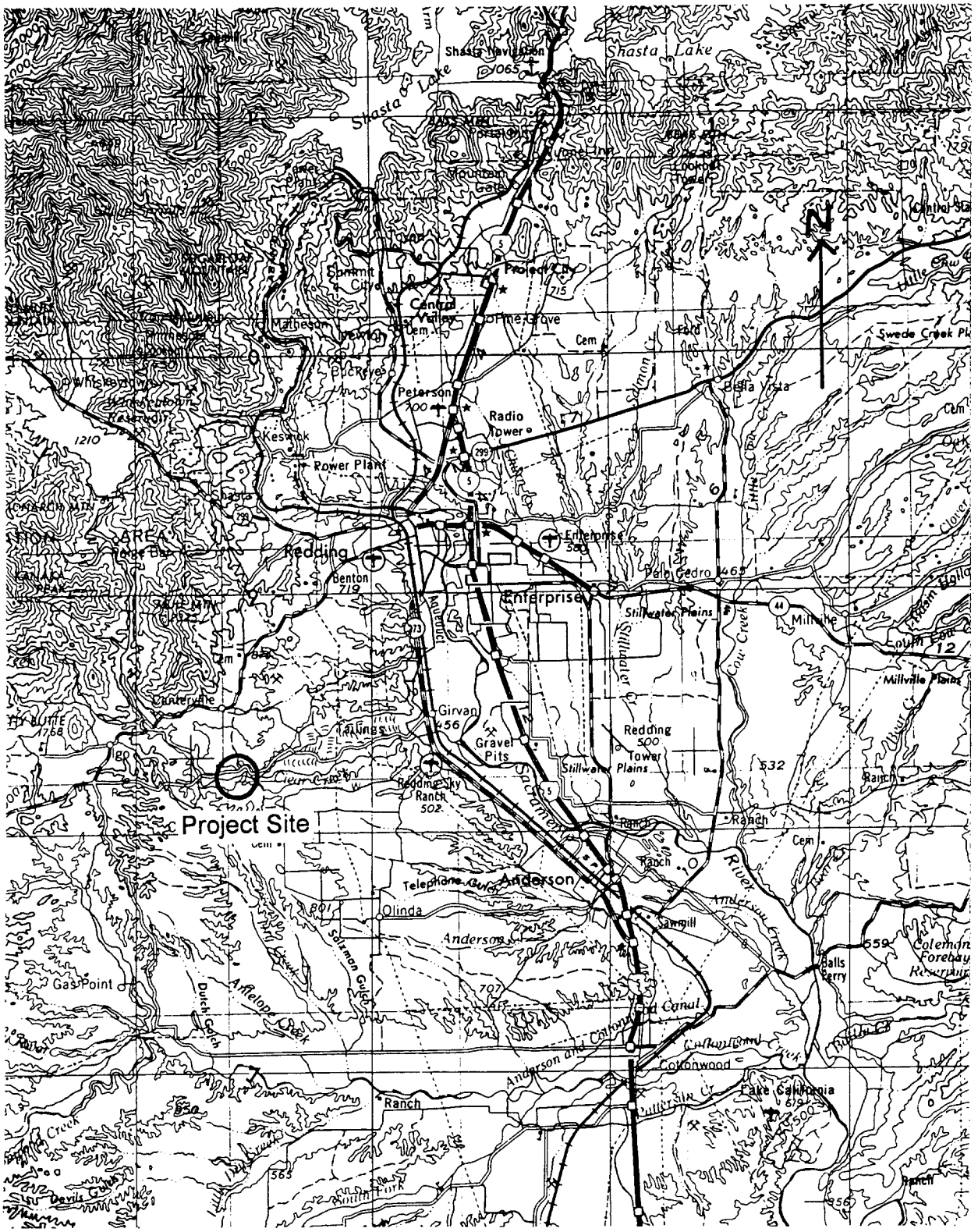


Figure 1 - Location Map. Scale 1:250,000

Notes:

1. Topographic base-map with seismic refraction line locations supplied by Northern District, and modified by Project Geology.
2. Location of Copley Greenstone (Dcgs) based on five outcrops and topographic expression of the site.
3. Qal = Quaternary Alluvium
   Dcgs = Copley Greenstone

LEGEND

- Seismic Refraction Line
- 10' Contour Line
- 2' Contour Line
- Edge of Water at 300 CFS
- Edge of Vegetation
- Dirt Road
- Drill Hole Location
- Test Pit Location
- Bedrock Outcrop
- Geologic Contact, dashed where inferred
- Geologic Cross Section Location

DRAWING SCALES

FULL SIZE

1" = 75' 75 0 75 150 225 300 SCALE OF FEET

REV.	DATE	DESCRIPTION

GEOLOGY REPORT No. 94 00 09

CONSTRUCTION SPEC. No.

GEOLOGY DRAWING No. PG-FS2-1

GEOLOGIC MAPPING AND/OR LOGGING BY: 1 BRENT LAWKIN 2

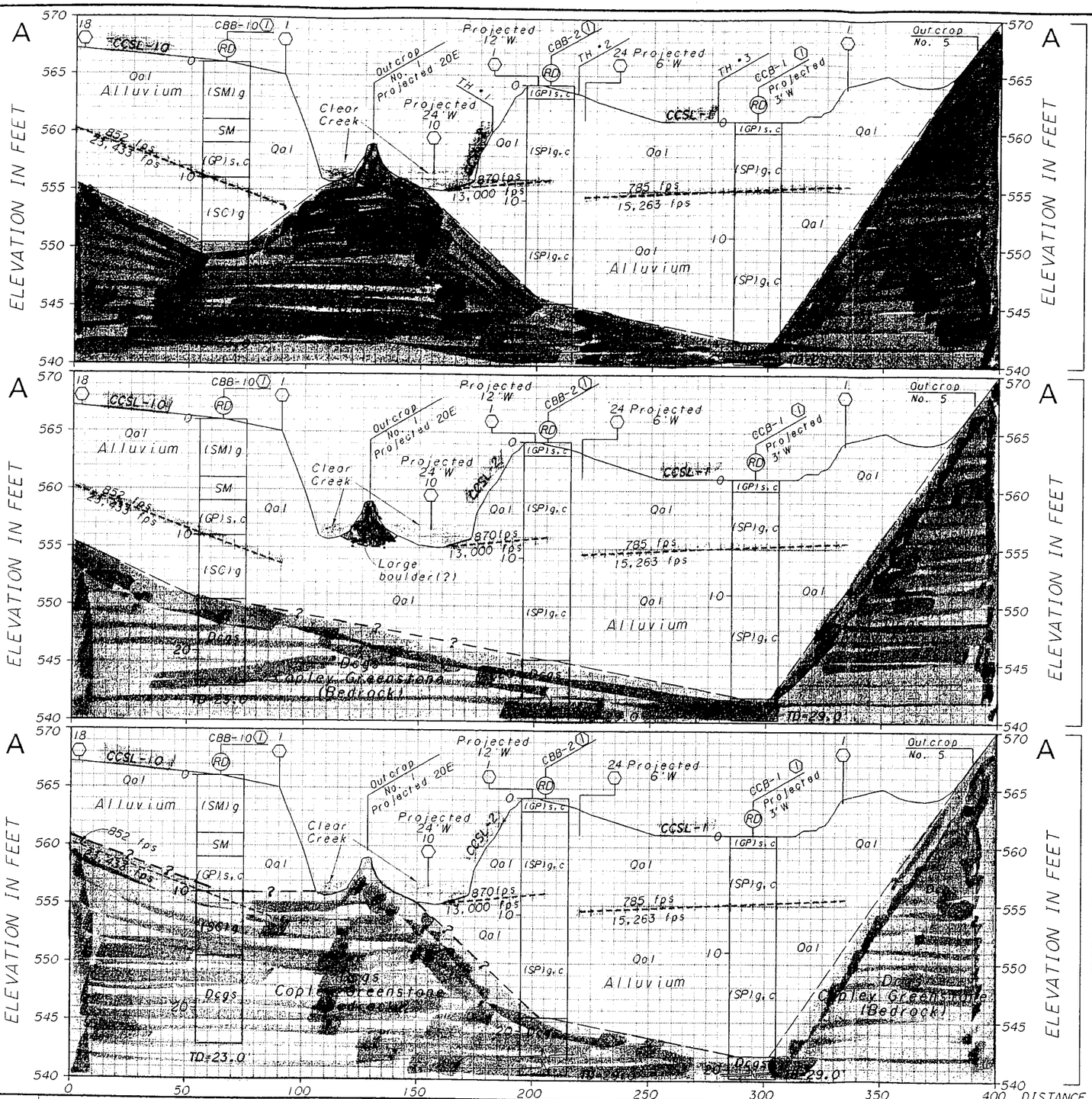
DRAWING PREPARED BY: F.NASIRIAN DATE: 12-15-97

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF ENGINEERING
PROJECT GEOLOGY SECTION
STATE WATER FACILITIES

SAELTZER DAM FISH PASSAGE PROJECT
PROPOSED UPSTREAM DAM SITE
Exploration and Site Geology Map

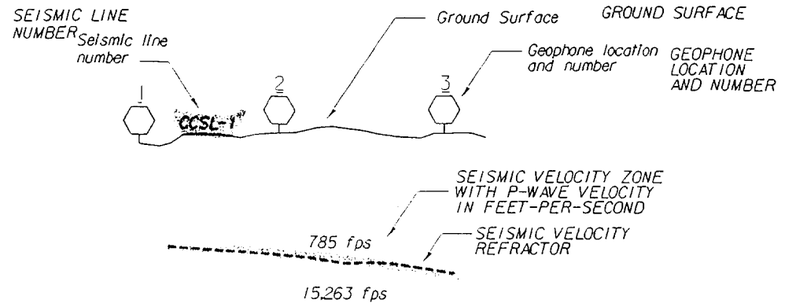
RELEASE DATE : 12-15-97
SHEET No. 1
PLATE 1

c:\dgn\abrant3.dgn VI-HALFCIVB.PEN 15-DEC-1997 c:\dgn\abrant3.dgn

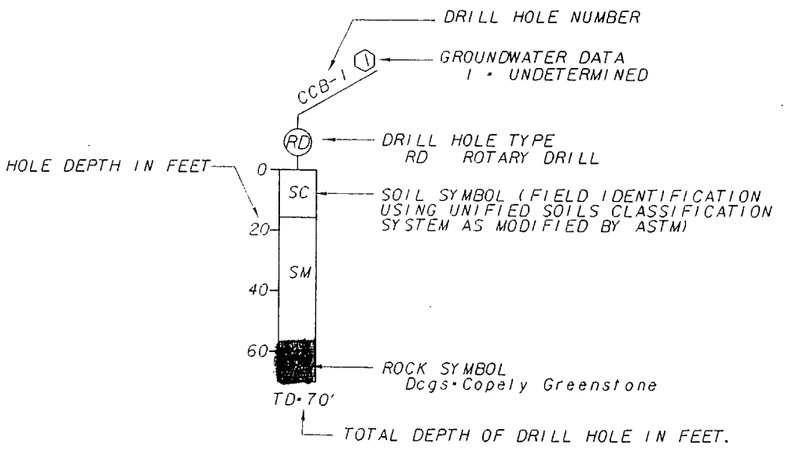


EXPLANATION

GEOPHYSICAL EXPLORATION DATA



DRILL HOLE DATA



GEOLOGIC CONTACT. DASHED WHERE INFERRED. QUESTIONED WHERE UNCERTAIN

? ? ?

DRAWING SCALES

1" = 5' — 5 0 5 10 15 20 — VERTICAL SCALE OF FEET

1" = 25' — 25 0 25 50 75 100 — HORIZONTAL SCALE OF FEET

REV.	DATE	DESCRIPTION

GEOLOGY REPORT No. 94 00 09
CONSTRUCTION SPEC. No.
GEOLOGY DRAWING No. PG-FS2-2

GEOLOGIC MAPPING AND/OR LOGGING BY:
1 BRENT LAWKIN
2
DRAWING PREPARED BY: A. LAGUARDIA DATE:

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF ENGINEERING
PROJECT GEOLOGY SECTION
STATE WATER FACILITIES

SAELTZER DAM FISH PASSAGE PROJECT
PROPOSED UPSTREAM DAM SITE

CROSS SECTION A-A

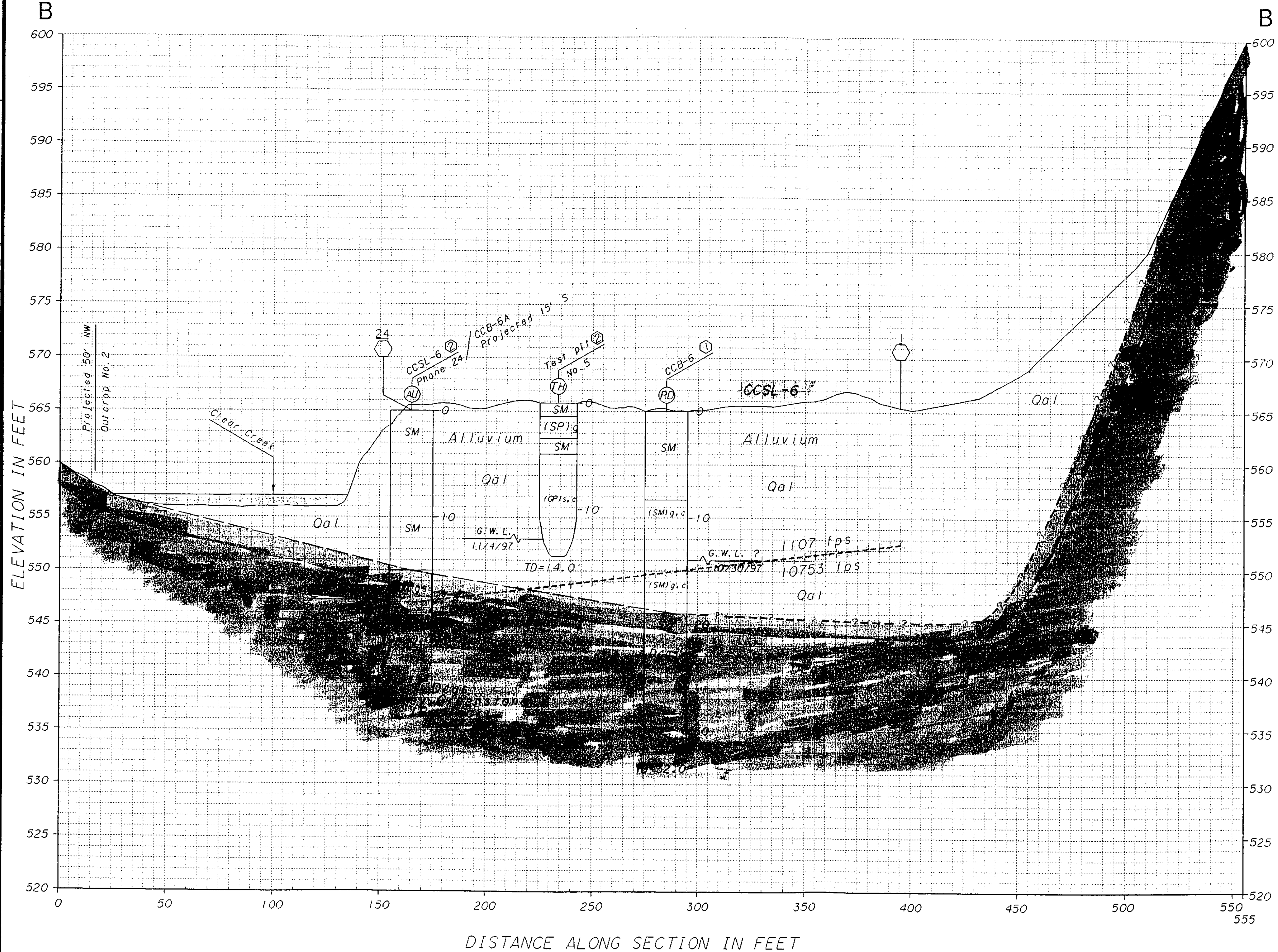
RELEASE DATE: 12-15-97
SHEET No. 1
PLATE 2

A B C D E F G H

/usr2/projects/brant/brant2.dgn

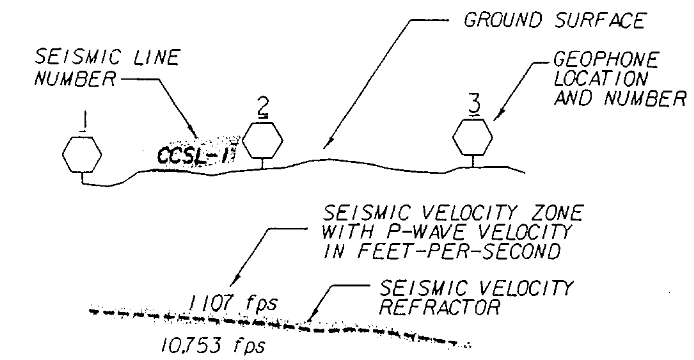
VI • HALFC(VB.PEN

5-DEC-1997 /usr2/projects/brant/brant2

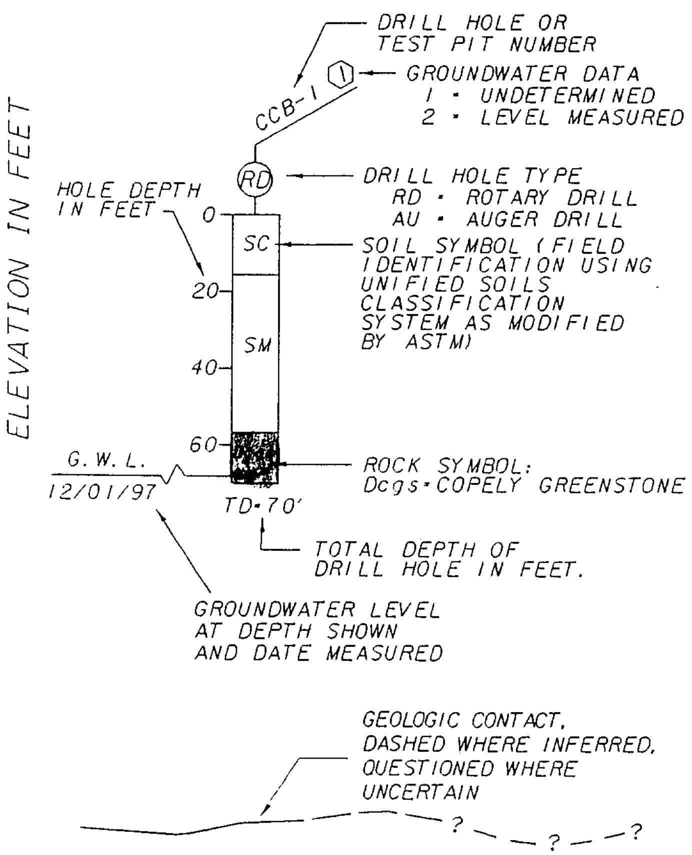


EXPLANATION

GEOPHYSICAL EXPLORATION DATA



DRILL HOLE AND TEST PIT DATA



REV.	DATE	DESCRIPTION

DRAWING SCALES

1" = 5' — VERTICAL SCALE OF FEET (5, 0, 5, 10, 15, 20)

1" = 25' — HORIZONTAL SCALE OF FEET (25, 0, 25, 50, 75, 100)

GEOLOGY REPORT No. 94 00 09

CONSTRUCTION SPEC. No.

GEOLOGY DRAWING No. PG-FS2-3

GEOLOGIC MAPPING AND/OR LOGGING BY: 1 BRENT LANKIN 2

DRAWING PREPARED BY: A. LAGUARDIA DATE:

STATE OF CALIFORNIA
THE RESOURCES AGENCY
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DIVISION OF ENGINEERING
PROJECT GEOLOGY SECTION
STATE WATER FACILITIES

SAELTZER DAM FISH PASSAGE PROJECT
PROPOSED UPSTREAM DAM SITE

CROSS SECTION B-B

RELEASE DATE: 12-15-97

SHEET No. 1

PLATE 3

/usr2/projects/brent/brent3.dgn — VI= HALFCIVB.PEN — 8-DEC-1997 /usr2/projects/brent/brent3

Notes:

1. Topographic base-map with seismic refraction line locations supplied by Northern District, and modified by Project Geology.
2. Location of Copley Greenstone (Dcgs) based on five outcrops and topographic expression of the site.
3. Qal = Quaternary Alluvium
   Dcgs = Copley Greenstone

10' Contour of estimated bedrock depth

LEGEND

- Seismic Refraction Line
- 10' Contour Line
- 2' Contour Line
- Edge of Water at 500 CFS
- Edge of Vegetation
- Dirt Road
- Drill Hole Location
- Test Pit Location
- Bedrock Outcrop
- Geologic Contact, dashed where inferred
- Geologic Cross Section Location

DRAWING SCALES

FULL SIZE

1" = 75' 75 3 75 150 225 300

SCALE OF FEET

REV.	DATE	DESCRIPTION

GEOLOGY REPORT NO. 94 00 09

CONSTRUCTION SPEC. No.

GEOLOGY DRAWING NO. PG-FS2-4

GEOLOGIC MAPPING AND/OR LOGGING BY: BRENT L. HAWKIN

DRAWING PREPARED BY: A. LAGUARDIA DATE: 12-15-97

STATE OF CALIFORNIA
THE RESOURCES AGENCY
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DIVISION OF ENGINEERING
PROJECT GEOLOGY SECTION
STATE WATER FACILITIES

SAELTZER DAM FISH PASSAGE PROJECT
PROPOSED UPSTREAM DAM SITE

MAP OF ESTIMATED BEDROCK DEPTH

RELEASE DATE: 12-15-97

SHEET No. 1

PLATE 4

APPENDIX A

DRILL HOLE AND TEST PIT LOGS

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

DRILL HOLE LOG

SHEET 1 of 2
HOLE NO. CCB-1
ELEV. 561.2 FEET
DEPTH 29.0 FEET
DATE DRILLED 10/28/97
ATTITUDE Vertical
LOGGED BY F. Glick/B. Lamkin
DEPTH TO WATER Not Determined

PROJECT Saeltzer Dam Fish Passage Project
FEATURE Proposed Upstream Dam Site
LOCATION Phone 8 of CCSL-1
CONTR. P.C. Exploration DRILL RIG Mobile B-53

AU= 8.0" o.d. hollow stem auger
HQ= HQ size wireline core drilling with a diamond bit using rotary wash methods
Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	(GP)sc	STREAM CHANNEL DEPOSITS			Began drilling using 8.0" hollow-stem auger
(560.0)	(SP)g	0.0 - 1.0' Poorly Graded Gravel with Sand and Cobbles (GP) s, c: About 80% subangular to rounded, fine to coarse, volcanic, granitic and metamorphic gravel; about 20% fine to coarse sand; about 15% (by volume) subangular to rounded cobbles up to .85'; gray; moist.		AU	0.0 - 4.0' Easy augering
2.0		1.0 - 19.0' Poorly Graded Sand with Gravel (SP)g: About 70% fine to medium sand, about 10% coarse sand, loose to compact; about 20% fine to coarse, subangular to subrounded gravel up to 2.7"; about 0 to 5% nonplastic fines; medium brown; moist to wet.			
4.0					4.0 - 9.0' Easy augering with occasional chatter
6.0		(Adjacent test pit TH#3 indicates a Poorly Graded Gravel with Sand and Cobbles; maximum size appears to be 10" diameter)		AU	
	(SP)g				Average auger speed is 1 foot per minute
8.0					
10.0					
(550.0)					
12.0					
14.0	(SP)g				
16.0					

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-1

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	(SP)g	STREAM CHANNEL DEPOSITS 1.0 - 19.0' Poorly Graded Sand with Gravel (cont.)		AU	0.0 - 19.0' Drilling with 8.0" hollow stem augers (cont.)
18.0					
(542.2)	Dcgs	COPLEY GREENSTONE 19.0 - 29.0' Greenstone (metabasalt?): Green-gray; hard; moderately strong (brittle); moderately to slightly weathered; intensely to closely fractured, dipping 20-60 , fracture faces coated with up to .1" $CaCo_3$ and/or pyrite; very siliceous, appears to have been recrystallized; light green lenses observed that may be epidote; aphanitic	Box 1	HQ .3/2.5	18.5' Augering difficult 19.0' Auger refusal, switched to HQ core and rotary wash 19.0 - 21.5' 10 min. RQD: 0% 85% fluid loss, gray
20.0					
22.0				HQ 1.2/2.5	21.5 - 24.0' 25 min. RQD: 0% 75% fluid loss, gray
24.0	Dcgs			HQ .9/1.5	24.0 - 25.5' 31 min. RQD: 0% 60% fluid loss, gray to clear
26.0			Box 1	HQ 1.2/3.5	Shoe blocked off 25.5 - 29.0' 15 min. RQD: 0% 60% fluid loss, gray and cloudy
28.0					Total Depth= 29.0' Hole backfilled with bentonite-cement grout
30.0					
32.0					

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SHEET 1 of 2

HOLE NO. CCB-2

ELEV. 564.3 FEET

DEPTH 29.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE DRILLED 10/29/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION Approximately 10' West of CCSL-2 Phone 1

LOGGED BY B. Lamkin

CONTR. P.C. Exploration DRILL RIG Mobile B-53

DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow stem auger
HQ= HQ size wireline core drilling with a diamond bit using rotary wash
Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	(GP)sc	STREAM CHANNEL DEPOSITS		AU	Began drilling using 8.0" hollow stem auger
		0.0 - 1.5' Poorly Graded Gravel with Sand and Cobbles (GP) s,c: About 80% subangular to rounded, fine to coarse, volcanic, granitic, and metamorphic gravel up to 3.0"; about 20% fine to coarse sand; about 20% (by volume) subangular to rounded cobbles and occasional boulders up to 1.3'.			0.0 - 7.0' Difficult augering, few cuttings
2.0	(SP)gc				
4.0		1.5 - 19.0' Poorly Graded Sand with Gravel and Cobbles (SP) g,c: About 55-60% fine to coarse sand, loose; about 40-45% fine to coarse, subangular to subrounded gravel up to 3.0"; about 5-10% (by volume) subangular to rounded cobbles up to 5.0"+; slightly moist to moist; medium brown.			
(560.0)					
6.0				AU	
	(SP)gc	(Adjacent test pits TH#1 and TH#2 show a Poorly Graded Gravel with Sand and Cobbles; maximum size appears to be at least 8" diameter)			7.0 - 10.0' Moderately difficult augering, some cuttings
8.0					
10.0					10.0 - 18.5' Moderate to easy augering
12.0		12.0 - 19.0' decrease in gravel size, up to 2.0"		AU	
14.0					
(550.0)	(SP)gc				
16.0					

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-2

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	(SP)gc	STREAM CHANNEL DEPOSITS 1.5 - 19.0' Poorly Graded Sand with Gravel and Cobbles (SP) g,c: (cont)		AU	0.0 - 19.0' Drilling using 8.0" hollow stem augers 18.5 - 19.0' Difficult Augering 19.0' Auger refusal switched to HQ core and rotary wash drilling
18.0					
20.0	Dcgs	COPLEY GREENSTONE 19.0 - 29.0' Greenstone (metabasalt?) Green-gray; slightly weathered; hard; moderately strong; intensely fractured, dipping 20-70°; C_aCO_3 and/or pyrite coating .1" thick on fracture faces; aphanitic, very siliceous, appears to have recrystallized, abundant fine pyrite	Box 1	HQ	19.0 - 24.0' 16 min. RQD: 0% 60% fluid loss; milky light gray Additional .8' of cobbles recovered
22.0		21.6 - 21.9' white C_aCO_3 vein, reacts to HCl only when powdered 22.1 - 22.2' healed shear, cemented fragments, upper surface dips 30°		2.3/5.0	22.0 - 23.5' Light brown fluid, 60-80% loss 23.5 - 24.0' Milky gray fluid
24.0		24.0 - 25.0' very hard and very strong		.7/1.0	24.0 - 25.0' 40 min. RQD: 40% Core broken extracting from core barrel shoe Hydraulic chuck jaws failed
26.0	Dcgs	25.0 - 29.0' closely fractured, dipping predominantly 30-50° ; healed fractures .1" - .4", C_aCO_3 infilling	Box 1	HQ	End of shift 10/29/97 25.0 - 29.0' 20 min. RQD: 20% 60-80% fluid loss; milky gray
28.0				2.4/4.0	
30.0					Total Depth= 29.0' Hole backfilled with cuttings

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SHEET 1 of 2

HOLE NO. CCB-3

ELEV. 567.0 FEET

DEPTH 30.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE DRILLED 10/29/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION CCSL-3, between phones 10 and 11

LOGGED BY B. Lamkin

CONTR. P.C. Exploration

DRILL RIG Mobile B-53

DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow stem auger

HQ= HQ size wireline core drilling with a diamond bit using rotary wash

Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	SP	STREAM TERRACE DEPOSITS 0.0 - 8.5' Poorly Graded Sand SP: About 90-95% fine sand, loose; about 5-10% non-plastic fines, rapid dilatancy; light brown; slightly moist to dry; occasional weathered mica		AU	Began drilling using 8.0" hollow-stem auger
2.0		3.0 - 5.0' dry			
4.0					
6.0	SP	6.0' occasional fine, rounded to sub-rounded gravel up to .5"		AU	6.0' Driller reports minor gravel
(560.0)					
8.0	(GP)sc	8.5 - 12.0' Poorly Graded Gravel with Sand and Cobbles (GP)s,c: Inferred from drill rig response (Maximum cobble dimension from nearby test pits is 8-10" diameter)			8.5 - 12.0' Cobbles? Difficult augering; no cuttings
10.0					
12.0	(SP)g	12.0 - 20.0' Poorly Graded Sand with Gravel (SP)g: Inferred from rig response (Maximum cobble dimension from nearby test pits is 8-10" diameter)		AU	12.0 - 20.0' Slow augering, no rig chatter
14.0					
16.0					

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-3

PROJECT & FEATURE Saeltzer Dam Fish Passage; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	(SP)g	STREAM TERRACE DEPOSITS			0.0 - 20.0' Drilling using 8.0" and hollow-stem augers (cont)
(550.0)		12.0 - 20.0' Poorly Graded Sand with Gravel (SP)g: (cont)		AU	
18.0					18.0 - 19.0' Occasional rig chatter - cobbles? no cuttings
		COPLEY GREENSTONE			
20.0					
(547.0)	Dcgs	20.0 - 30.0' Greenstone (Metabasalt?): Dark gray to black; slightly weathered; moderately hard; weak to moderately strong; intensely to closely fractured, dipping 20-70°, fracture faces coated with $CaCO_3$ and/or pyrite; about 85-90% of rock is mylonitic with a moderate to strong foliation dipping 10-15°; aphanitic; abundant pyrite mineralization; slaty texture	Box 1	HQ	20.0' Auger refusal Began coring with HQ wireline core barrel, rods, and diamond impregnated bit
22.0					20.0 - 25.0' 25 min. RQD: 15% 70% fluid loss; dark, cloudy gray
					23.0' Return fluid clear
24.0				2.3 / 5.0	23.5' Return fluid gray
				HQ	25.0 - 27.0' 19 min. RQD: 0%
26.0				.8 / 2.0	
(540.0)					27.0' Blocked-off
				HQ	27.0 - 30.0' 16 min. RQD: 0% 70% fluid loss; gray and cloudy
28.0	Dcgs	28.6 - 29.0' Mottled, dark gray greenstone with fragments of mylonite; relict amygdules up to .2"			
		29.6 - 29.9' Mottled, dark gray greenstone, relict amygdules? up to .3"		2.8 / 3.0	
30.0					Total Depth= 30.0' Hole backfilled with bentonite-cement grout.

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SHEET 1 of 1

HOLE NO. CCB-5

ELEV. 566.8 FEET

DEPTH 15.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE DRILLED 11/4/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION CCSL-5, Phone 12

LOGGED BY B. Lamkin

CONTR. P.C. Exploration DRILL RIG Mobile B-53

DEPTH TO WATER Not Encountered

AU= 8.0" o.d. hollow-stem auger
Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	(SP)g	STREAM TERRACE DEPOSITS 0.0 - 8.0' Poorly Graded Sand with Gravel (SP)g: About 50% fine sand, about 30-35% medium to coarse sand, loose; about 15-20% fine, subangular to sub-rounded gravel up to 1.5"; medium brown; slightly moist		AU	Began drilling using 8.0" o.d. hollow stem augers 0.0 - 8.0' Easy to moderately difficult augering
2.0					
4.0					
6.0 (560.0)	(SP)g			AU	
8.0	(GP)sc	8.0 - 15.0' Poorly Graded Gravel with Sand and Cobbles (GP)s,c: About 60% fine to coarse, subangular to rounded gravel up to 3.0"; about 40% fine to coarse sand; medium to olive brown; slightly moist to moist (Maximum cobble dimension from nearby test pit is .8')			8.0 - 15.0' Moderately difficult to difficult augering - cobbles?
10.0					
12.0				AU	
14.0	(GP)sc				15.0' Auger refusal Backfilled with cuttings
16.0					

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SHEET 1 of 2

HOLE NO. CCB-6

ELEV. 565.7 FEET

DEPTH 32.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE DRILLED 10/30/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION CCSL-8, Phone 1

LOGGED BY B. Lamkin

CONTR. P.C. Exploration DRILL RIG Mobile B-53

DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow stem auger
HQ= HQ size wireline core drilling with a diamond bit using rotary wash methods
Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	SM	STREAM TERRACE DEPOSITS 0.0 - 9.0' Silty Sand SM: About 80-85% fine sand, loose; about 15-20% non-plastic fines, rapid dilatancy, medium dry strength; abundant mica; medium brown; dry to slightly moist		AU	Began drilling using 8.0" hollow-stem augers 0.0 - 9.0' Easy augering, low rpm
2.0		3.0 - 8.0' ? Dry Nearby test pit TH#5 indicates: 0.0 - 1.0' Silty Sand 1.0 - 3.0' Poorly Graded Sand with Gravel 3.0 - 4.5' Silty Sand 4.5 - 14.0' Poorly Graded Gravel with Sand and Cobbles			
4.0					
(560.0)					
6.0	SM			AU	
8.0					
10.0	(SM)gc	9.0 - 19.5' Silty Sand with Gravel and Cobbles? (SM) g,c: About 60% fine to medium sand, loose to compact; about 25% nonplastic fines, rapid dilatancy, high dry strength; about 15% subangular to subrounded, fine to coarse gravel up to 1.6"; medium to yellow-brown; moist no reaction to HCl (Maximum cobble dimension from nearby test pit is .8')			9.0 - 14.0' Moderately difficult drilling - grinding on cobbles/ gravel
12.0				AU	12.0' No cuttings
14.0		14.0 Water?			14.0 - 19.5' Very slow, difficult augering; gravel and cobbles? Wet cuttings
(550.0)					
16.0					

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-6

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	(SM)g.c	STREAM TERRACE DEPOSITS 9.0 - 19.5' Silty Sand with Gravel and Cobbles (cont)		AC	0.0 - 19.5' Drilling using 8.0" o.d. hollow-stem auger (cont)
18.0					19.5' Auger refusal; switched to HQ core drilling using rotary wash
20.0	Dcgs	COPLEY GREENSTONE 19.5 - 32.0' Greenstone (Metabasalt): Gray-green, slightly weathered; hard to very hard; strong: intensely fractured, dipping 30-70°, fracture faces coated with $CaCO_3$ and/or pyrite to .1" thick, massive; aphanitic; 15-20% mylonite	Box 1	HQ 0 2.5	19.5 - 22.0' 12 min. RQD: 0% 40-60% fluid loss; cloudy brown
22.0		Mylonite - Black; hard; moderately strong; intensely fractured, dipping 30-80°, fracture faces coated with pyrite and/or $CaCO_3$ up to .1"; moderate to strong foliation, dipping 30-40°; abundant pyrite; slaty texture			No recovery - core lost - ground up 22.0 - 27.0' 38 min. RQD: 0% 60-70% fluid loss 22.0 - 24.0' 100% fluid loss
24.0					24.0 - 27.0' Slow feed due to loss
26.0		25.3 - 25.7' Mylonite 26.0 - 26.3' Mylonite; possible shear, 100% fragments, 40° dip 27.0 - 29.0' Gray-green mottling, relict amygdules? up to .4"; intensely to closely fractured		1.7 5.0	
28.0				HQ	27.0 - 32.0' 15 min. RQD: 15% 80% fluid loss; cloudy gray
	Dcgs	29.0 - 30.3' Mylonite; foliation dips 25-40°; abundant $CaCO_3$ and pyrite veins; lower contact dips 50° normal to foliation	Box 1		
30.0		30.3 - 32.0' 40° dip along moderate foliation, with pyrite up to .1" thick; dipping 35-40°		4.5 5.0	
32.0		31.5 - 31.7' Shear, 100% fragments, 35° dip			Total Depth = 32.0' Hole backfilled with cuttings and bentonite-cement grout
36.0					
38.0					

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SHEET 1 of 2

HOLE NO. CCB-6A

ELEV. 565.0 FEET

DEPTH 20.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE DRILLED 11/4/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION 15' North of CCSL-6 Phone 24

LOGGED BY B. Lamkin

CONTR. P.C. Exploration DRILL RIG Mobile B-53

DEPTH TO WATER About 18.0'

AU= 8.0" o.d. hollow-stem auger

Hole logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	SM	STREAM TERRACE DEPOSITS 0.0 - 16.0' Silty Sand (SM): About 45-50% fine sand, about 25% medium to coarse sand, loose; about 20% non-plastic fines; about 5-10% fine to coarse, subangular to subrounded gravel up to 2.5"; yellow-brown; dry to slightly moist.		AU	Began drilling using 8.0" o.d. hollow-stem auger 0.0 - 10.0' Easy augering at low rpm
2.0					
4.0		Nearby test pit #5 indicates: 0.0 - 1.0' Silty Sand 1.0 - 3.0' Poorly Graded Sand with Gravel 3.0 - 4.5' Silty Sand 4.5 - 14.0' Poorly Graded Gravel with Sand and Cobbles; with a maximum size of .8'.			
(560.0)					
6.0					
8.0				AU	
	SM				
10.0		10.0 - 12.0' Cobbles and gravel?			10.0 - 12.0' Easy to moderately difficult augering; cobbles at 10'?
12.0					12.0 - 16.5' Easy augering
				AU	
14.0					
(550.0)					15.0 - 16.5' No cuttings
16.0					

State of California
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DEPARTMENT OF WATER RESOURCES

DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-6A

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0 (549.0)	Dcgs	COPLEY GREENSTONE 16.0 - 20.0' Greenstone (metabasalt): black; slightly weathered; moderately hard; moderately strong; 100% mylonite; slaty texture; carbonaceous? consistency and staining		AU	0.0 - 20.0' Drilling with 8.0" o.d. hollow-stem auger (cont) 16.5' Moderately difficult augering 18.5' Wet cuttings
18.0					
20.0					20.0' Auger refusal Total Depth= 20.0' Hole back filled with cuttings

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SHEET 1 of 1

HOLE NO. CCB-7

ELEV. 564.0 FEET

DEPTH 14.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

FEATURE Proposed Upstream Dam Site

LOCATION CCSL-7 between Phones 22 and 23

CONTR. P.C. Exploration DRILL RIG Mobile B-53

DATE DRILLED 11/4/97

ATTITUDE Vertical

LOGGED BY B. Lamkin

DEPTH TO WATER Not Encountered

AU= 8.0" o.d. hollow-stem auger

Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	SM	STREAM TERRACE DEPOSITS 0.0 - 6.0' Silty Sand (SM): About 60% fine sand, about 20% medium to coarse sand, loose; about 20% non-plastic fines; trace of fine gravel, subrounded to rounded up to .8"; yellow-brown; dry to slightly moist.		AU	Began drilling using 8.0" o.d. hollow-stem augers. 0.0 - 7.5' Easy augering
2.0					
	SM				
4.0 (560.0)					4.0 - 7.5' Occasional gravel/cobble grinding-rig chatter
6.0	(SM)g	6.0 - 11.0' Silty Sand with Gravel (SM)g: About 55-60% fine to coarse sand, loose to compact; about 20% non-plastic fines; about 15-20% subangular to subrounded fine gravel up to 1.0"; yellow-brown; slightly moist.		AU	7.5 - 11.0' Moderately difficult augering - some rig chatter
8.0					
10.0					
	(GP)s,c	11.0 - 14.0' Poorly Graded Gravel with Sand and Cobbles (GP) s,c: About 55% fine to coarse, subangular to subrounded gravel up to 3.0"; about 35-40% fine to coarse sand; about 5-10% non-plastic fines; medium brown; slightly moist to moist.			11.0 - 13.0' Difficult augering
12.0				AU	13.0 - 14.0' Moderately difficult augering
14.0 (550.0)		Nearby test pit TH#4 indicates: 0.0 - 1.0' Silty Sand 1.0 - 4.0' Poorly Graded Sand with Gravel and Cobbles 4.0 - 12.0 Poorly Graded Gravel with Sand and Cobbles; with a maximum dimension of .9'.			14.0' Auger refusal, probable large cobbles Total Depth= 14.0' Hole back filled with cuttings.
16.0					

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SHEET 1 of 2
HOLE NO. CCB-7A (1)
ELEV. 564.5 FEET
DEPTH 24.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project
DATE DRILLED 11/3/97
FEATURE Proposed Upstream Dam Site
ATTITUDE Vertical
LOCATION 60' North of CCSL-7 Phone 1
LOGGED BY B. Lamkin
CONTR. P.C. Exploration
DRILL RIG Mobile B-53
DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow-stem auger
HQ= HQ size wire line core drilling with a diamond bit using rotary wash methods

Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	(GP)s,c	STREAM TERRACE DEPOSITS 0.0 - 10.0' Poorly Graded Gravel with Sand and Cobbles (GP)s,c: About 65% sub-angular to rounded, fine to coarse gravel up to 3.0"; about 30% fine to coarse sand, loose to compact; about 5% non-plastic fines; about 10-20% (by volume) subangular to rounded, volcanic, granitic and metamorphic cobbles up to 7.0"; yellow-brown; dry to slightly moist.		AU	Began drilling using 8.0" o.d. hollow-stem augers 0.0 - 10.0' Moderate to difficult augering
2.0					
4.0					
(560.0)					
6.0					
	(GP)s,c			AU	
8.0					
10.0	(SM)g,c	10.0 - 14.0' Silty Sand with Gravel and Cobbles (SM) g,c: About 60% fine to coarse sand; about 15-20% non-plastic fines; about 20-25% fine to coarse, sub-angular to subrounded gravel; light brown to yellow brown; slightly moist to moist; about 5-15% cobbles (by volume) (Maximum cobble dimension from nearby test pit is .9')		AU	10.0 - 14.0' Moderate to easy augering
12.0					
14.0		14.0 - 19.5' Poorly Graded Gravel with Sand and Cobbles (GP) s,c: About 60% fine to coarse gravel; about 40% fine to coarse sand, about 20-30% (by volume) subangular to round cobbles	Box 1	HQ .8 5.0	14.0' Auger refusal; changed to HQ coring 14.0 - 19.0' 20 min. RQD: 0% 10-20% fluid loss, dark gray cobbles only
(550.0)	(GP)s,c				
16.0					

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-7A (1)

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	(GP)s_fc	STREAM TERRACE DEPOSITS 14.0 - 19.5' Poorly Graded Gravel with Sand and Cobbles (cont) (Maximum cobble dimension from nearby test pit is .9')	Box 1	HQ .8 5.0	14.0 - 19.0' (cont) 17.0 - 17.5' Return fluid light gray .8' cobbles
18.0		COPLEY GREENSTONE			
(545.0)		19.5 - 24.0' Greenstone (metabasalt) black; slightly weathered to fresh; hard; strong; intensely to closely fractured; 100% mylonite, weak to moderate foliation dipping 30-40; slaty texture		.15 1.0	19.0 - 20.0' 10 min. RQD: 0%
20.0	Dcgs			HQ .2 2.0	10-20% fluid loss; dark gray 20.0 - 22.0' 8 min. RQD: 0% 10-20% fluid loss; dark gray
22.0	Dcgs		Box 1	HQ 0 2.0	Core broken up 22.0 - 24.0' 6 min. No recovery - bit chewing up core
24.0					Total Depth= 24.0' Hole back filled with cuttings

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SHEET 1 of 2
HOLE NO. CCB-7A (2)
ELEV. 564.5 FEET
DEPTH 21.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project
DATE DRILLED 11/4/97
FEATURE Proposed Upstream Dam Site
ATTITUDE Vertical
LOCATION 64' North of CCSL-7 Phone 1
LOGGED BY B. Lamkin
CONTR. P.C. Exploration DRILL RIG Mobile B-53
DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow-stem auger
HQ= HQ size wire line core drilling with diamond bit using rotary wash methods
Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0		STREAM TERRACE DEPOSITS			Began drilling using 8.0" o.d. hollow-stem augers
	(GP)s,c	0.0 - 10.0' Poorly Graded Gravel with Sand and Cobbles (GP)s,c: About 65% sub-angular to rounded, fine to coarse gravel up to 3.0"; about 30% fine to coarse sand, loose to compact; about 5% non-plastic fines; about 10-20% (by volume) subangular to rounded, volcanic, granitic and metamorphic cobbles up to 7.0"; yellow-brown; dry to slightly moist		AU	0.0 - 10.0' Moderate to difficult augering
2.0					
4.0					
(560.0)					
6.0					
8.0	(GP)s,c			AU	
10.0		10.0 - 14.0' Silty Sand with Gravel and Cobbles (SM)g,c: About 60% fine to coarse sand; about 15-20% non-plastic fines; about 20-25% fine to coarse, sub-angular to subrounded gravel; light brown to yellow-brown; slightly moist to moist; about 5-15% (by volume) cobbles (Maximum cobble dimension from nearby test pit is .9')			10.0' Auger refusal changed to HQ coring
	(SM)g,c		Box 1	HQ 1.0/2.0	10.0 - 12.0' 10 min. RQD: 0% 20-40% fluid loss; olive gray - cobbles
12.0				.4/1.0	12.0 - 13.0' 14 min. Cobbles 40% fluid loss - gray
				.4/1.0	13.0 - 14.0' 9 min. Cobbles Blocked off
14.0		14.0 - 15.5' Poorly Graded Gravel with Sand and Cobbles (GP) s,c: About 60% fine to coarse gravel; about 40% fine to coarse sand; about 20-30% (by volume) subangular to rounded cobbles (Maximum cobble dimension from nearby test pit is .9')		HQ	14.0 - 16.0' 20 min. RQD: 0% 50% fluid loss; dark gray at 14.0'
	(GP)s,c			.6/2.0	Blocked off
(549.0)					
16.0	Dcgs				

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-7A (2)

PROJECT & FEATURE Saeltzer Dam Fish Passage Project

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	Dcgs	COPLEY GREENSTONE 15.5 - 21.0' Greenstone (metabasalt): Gray-green to black; slightly weathered; moderately hard to hard; strong; intensely to closely fractured; predominantly mylonitic (70-80%) showing weak to moderate foliation dipping 30-40°; slaty texture	Box 1	HQ .2 1.5 HQ 1.0 3.0 0/.5	16.0 - 17.5' 7 min. RQD: 0% 50% fluid loss; gray core ground up? over-drilled 17.5 - 20.5' 20 min. RQD: 0% 30-40% fluid loss, dark gray 1 cup liquid polymer added .4' core .6' cobbles 20.5 - 21.0' 18 min. No recovery Changed to open face bit 21.0 - 21.0' 18 min. No progress Total Depth= 21.0' Hole back filled with cuttings
18.0					
20.0	Dcgs				
22.0					

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DRILL HOLE LOG

SHEET 1 of 2
HOLE NO. CCB-9
ELEV. 563.9 FEET
DEPTH 30.5 FEET

PROJECT Saeltzer Dam Fish Passage Project
DATE DRILLED 10/30-31/97
FEATURE Proposed Upstream Dam Site
ATTITUDE Vertical
LOCATION CCSL-9, between Phones 4 and 5
LOGGED BY B. Lamkin
CONTR. P.C. Exploration
DRILL RIG Mobile B-53
DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow-stem auger
HQ= HQ size wire line core drilling with a diamond bit using rotary wash
Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	SM	STREAM TERRACE DEPOSITS 0.0 - 7.0' Silty Sand (SM): About 80-85% fine sand, loose; about 15-20% non-plastic fines, rapid dilatancy; abundant mica; medium brown; dry to slightly moist 2.0 - 7.0' Dry		AU	Began drilling using 8.0" o.d. hollow-stem augers 0.0 - 7.0' Easy augering, low rpm
2.0					
(560.0)					
4.0					
6.0	SM			AU	
	(GP)s,c	7.0 - 19.0' Poorly Graded Gravel with Sand and Cobbles (GP) s,c: About 55% fine to coarse, subangular to subrounded gravel up to 3.0"; about 35-40% fine to coarse sand; loose; about 5-10% non-plastic fines; yellow-brown; slightly moist; about 10-30% (by volume) subangular to subrounded cobbles			7.0 - 9.0' Difficult augering - "rock"/ cobbles; no cuttings 9.0 - 15.0' Moderate to difficult augering; fine to coarse gravel cuttings
8.0					
10.0					
12.0		12.0 - 3.5" Subangular cobble Nearby test pit TH#4 indicates: 0.0 - 1.0' Silty Sand 1.0 - 4.0' Poorly Graded Sand with Gravel and Cobbles 4.0 - 12.0' Poorly Graded Gravel with Sand and Cobbles; with a maximum dimension of .9'		AU	
(550.0)					
14.0	(GP)s,c				15.0' Auger refusal changed to HQ coring End of shift 10/30/97 15.0 - 16.0' 12 min. RQD: 0% Blocked off
16.0			Box 1	HQ .2 1.0	

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-9

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	(GP)s,c	STREAM TERRACE DEPOSITS 7.0 - 19.0' Poorly Graded Gravel with Sand and Cobbles (cont)	Box 1	1.5	16.0 -16.5' Blocked off
				HQ	16.5 - 16.65' Blocked off, inner gauge of bit worn - replaced
				.15	
18.0				2.35	16.65 - 18.5' 9 min. RQD: 0%
(549.9)	Dcgs	19.0 - 30.5' Greenstone (Metabasalt): Gray-green to black; slightly weathered; hard; moderately strong to strong; intensely to closely fractured dipping 15-80°, fracture faces coated with C_aCO_3 and/or pyrite, healed fractures consist of quartz infilling; aphanitic; about 40% mylonite		HQ	0% fluid loss; milky gray mylonite cuttings End of shift 10/31/97 18.5 - 21.5' 8 min. Core slid out of barrel, lost down hole; over - drilled to recover
20.0				2.5	18.5 - 23.5' 18 min.
22.0		Mylonite - Black to gray; slightly weathered; moderately hard to hard; moderately strong to strong; intensely to closely fractured, dipping predominantly 40° along foliation, thin coating of pyrite and/or C_aCO_3 on fracture faces up to .2", healed fractures up to .7" thick; strongly foliated dipping 40°; aphanitic; slaty texture		5.0	RQD: 14% 0% fluid loss; 22.5' change from light gray to dark gray 18.5 - 21.5' Most of core lost
(540.0)				HQ	23.5 - 28.5' 18 min.
24.0					RQD: 20% 0% fluid loss, dark gray 22.5-25.0'; light gray 25.0 - 30.5'
			Box 1		
26.0		26.3 - 27.9' Black mylonite			
	Dcgs	27.8 - 27.9' Quartz vein 27.9 - 28.5' Gray mylonite		3.0	
28.0				5.0	
				HQ	28.5 - 30.5' 12 min. RQD: 0% 0% fluid loss
30.0				1.0 2.0	
					Total Depth= 30.5' Hole back filled with bentonite-cement grout
32.0					
34.0					
36.0					

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SHEET 1 of 2
HOLE NO. CCB-10
ELEV. 566.1 FEET
DEPTH 23.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project
DATE DRILLED 11/6/97
FEATURE Preposed Upstream Dam Site
ATTITUDE Vertical
LOCATION 25' North of CCSL-10 Phone 1
LOGGED BY B. Lamkin
CONTR. P.C. Exploration
DRILL RIG Mobile B-53
DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow-stem auger
HQ= HQ size wire line core drilling with a diamond bit using rotary wash
Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	(SM)g	STREAM TERRACE DEPOSITS 0.0 - 5.0' Silty Sand with Gravel (SM)g: About 50% fine sand, about 15% medium to coarse sand, loose to compact; about 20% non-plastic fines, rapid dilatancy; about 15% fine to coarse, subangular to subrounded gravel up to 1.9"; yellow-brown; slightly moist		AU	Began drilling using 8.0" o.d. hollow-stem augers 0.0 - 7.0' Easy augering
2.0					
4.0					
6.0 (560.0)	SM	5 0 - 7.0' Silty Sand (SM): About 55% fine sand, about 10% medium to coarse sand, loose to compact; about 25% non- to low plasticity fines, slow dilatancy; about 10% fine, subangular to subrounded gravel up to 1.0"; light brown to yellow-brown; dry		AU	
8.0	(GP)s,c	7.0 - 10.0' Poorly Graded Gravel with Sand and Cobbles (GP) s,c: About 70% fine to coarse, subangular to subrounded gravel up to 3.0"; about 20% fine to coarse sand; about 5% non-to low plasticity fines; yellow-brown to gray (gravel); slightly moist; unknown volume of cobbles (maximum cobble dimension from nearby test pit is 8-10")			7.0 - 10.0' Moderate to difficult augering-cobbles?
10.0	(SC)g	10.0 - 15.6' Clayey Sand with Gravel (SC)g: About 35% fine sand, about 20% medium to coarse sand, compact; about 30-35% low plasticity fines, slow dilatancy; about 10-15% fine, angular to subrounded gravel up to .7"; orange-brown; dry to slightly moist(may be decomposed greenstone)			10.0 - 14.0' Moderate augering 11.0 - 12.0' No cuttings
12.0				AU	
14.0		COPLEY GREENSTONE			15.0' Auger refusal; switched to HQ coring
16.0	Dcgs	15.6 - 23.0' Greenstone (Metabasalt)	Box 1	HQ	15.0 - 18.0' 25 min. RQD: 13% 10-20% fluid loss; brown-gray

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DRILL HOLE LOG

SHEET 2 OF 2

HOLE NO. CCB-10

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0 (550.0)	Dcgs	COPLEY GREENSTONE 15.5 - 23.0' Greenstone (Metabasalt): Green-gray; slightly weathered; hard; strong; intensely to closely fractured, dipping 10-80° (predominantly 40-60°), fracture faces coated with up to .1" iron-oxide, pyrite, and/or C_aCO_3, healed fractures filled with quartz up to .35" thick; aphanitic; appears to have been recrystallized 17.0' Relict amygdules? Cicular to oval, white, hard, .1-.3" 18.0 - 19.6' Light green, quartz and plagioclase (?) dominant 19.0 - 19.1' Quartz vein, 30° dip across predominant fracture direction	Box 1	HQ 2.9/3.0 HQ 3.7/5.0	15.0 - 18.0' (cont) RQD: 13% 10-20% fluid loss, brown-gray First .6' cobbles 18.0 - 23.0' 40 min. RQD: 18% 10-20% fluid loss, brown-gray Core loss 21.3 - 22.6' Fell out of core barrel during recovery
18.0					
20.0					
22.0					Total Depth = 23.0' Hole backfilled with cuttings
24.0					
26.0					

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SHEET 1 of 1

HOLE NO. CCB-11

ELEV. 565.2 FEET

DEPTH 12.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE DRILLED 11/6/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION Phone 18 of CCSL-11

LOGGED BY B. Lamkin

CONTR. P.C. Exploration DRILL RIG Mobile B-53

DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow-stem auger

Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	(SM)g,c	STREAM TERRACE DEPOSITS 0.0 - 2.5' Silty Sand with Gravel and Cobbles (SM)g,c: About 60% fine to coarse sand, loose to compact; about 15-20% non-plastic fines, rapid dilatancy; about 20-25% fine to coarse, subangular to subrounded gravel up to 3.0"; yellow-brown to medium brown; slightly moist to dry; unknown volume of cobbles		AU	Began drilling using 8.0" o.d. hollow-stem augers 0.0 - 2.5' Easy augering 2.5 - 12.0' Moderate to difficult augering 2.5 - 6.5' Predominantly gravel cuttings
2.0					
	(GP)s,c	2.5 - 12.0' Poorly Graded Gravel with Sand and Cobbles (GP) s,c: About 60% fine to coarse; subangular to rounded gravel up to 3.0"; about 35% fines to coarse sand; about 5% non-plastic fines; about 10% subrounded cobbles up to 5.0" (by volume); gray-brown; slightly moist			
4.0					
(560.0)					
6.0		6.5 - 10.5' Predominantly fine gravel			6.5 - 8.0' Predominantly sand cuttings
				AU	
8.0					8.0 - 12.0' Predominantly gravel cuttings, little sand
	(GP)s,c				
10.0		10.0 - 10.5' Increasing coarse sand content (about 15%) (Maximum cobble dimension from nearby test pit is 8-10")			
12.0					12.0' Hole terminated because of mechanical failure Total Depth = 12.0' Hole back filled with cuttings
14.0					
16.0					

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SHEET 1 of 2

HOLE NO. CCB-13

ELEV. 569.0 FEET

DEPTH 25.0 FEET

DRILL HOLE LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE DRILLED 11/5/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION About 5 feet West of CCSL-13, Phone 13

LOGGED BY B. Lamkin

CONTR. P.C. Exploration DRILL RIG Mobile B-53

DEPTH TO WATER Not Determined

AU= 8.0" o.d. hollow-stem auger
HQ= HQ size wire line core drilling with a diamond bit using rotary wash

Soils logged from cuttings

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	(SP)g	STREAM TERRACE DEPOSITS 0.0 - 7.5' Poorly Graded Sand with Gravel (SP)g: About 50% fine to medium sand, about 10% coarse sand, loose to compact; about 30-35% fine to coarse, subangular to rounded gravel up to 3.0"; buff to reddish tan; dry to moist 0.0 - 1.0' Moist		AU	Began drilling with 8.0" o.d. hollow-stem augers 0.0 - 8.0' Easy augering
2.0					
4.0					
		5.5 - 7.5' High sand content (80%); gravel predominantly fine, reddish brown (Maximum cobble dimension from nearby test pit is .9')		AU	
8.0	s(CL)	7.5 - 11.0' Sandy Lean Clay s(CL): About 70% low to medium plasticity fines, low toughness, moderate dry strength, slow dilatancy; about 30% fine to coarse sand (predominantly fine); red-brown; dry to slightly moist (weathered bedrock?)			8.0 - 15.0' Moderate to difficult augering; cobbles? weathered bedrock?
(560.0)		COPLEY GREENSTONE			
10.0		11.0 - 25.0' Greenstone (Metabasalt): Gray to dark gray; moderately to slightly weathered; hard; strong; closely fractured, 40-60 dip; fracture faces and vein fillings coated with C_aCO_3 and/or pyrite up to .1" thick; aphanitic; approximately 60% of rock is mylonitic			
12.0	Dcgs			AU	11.0 - 15.0' Cuttings gray-brown to black; hard, angular to subangular rock fragments .3" - 1.2"
14.0		Mylonite - Dark gray; aphanitic; hard; moderately strong to strong; moderately weathered; intensely to closely fractured, dipping 30-45° and 80°, fracture faces coated with pyrite, iron oxide, and/or C_aCO_3; moderately foliated with 40° dip; slaty texture			15.0' Auger refusal; switched to HQ coring 15.0 - 19.5' 25 min. RQD: 0%
	Dcgs		Box 1	HQ	
16.0					

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

SHEET 2 OF 2
HOLE NO. CCB-13

PROJECT & FEATURE Saeltzer Dam Fish Passage Project

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
16.0	Dcgs	COPLEY GREENSTONE 11.0 - 25.0' Greenstone (cont) 11.0 - 18.5' Mylonite	Box 1	HQ	15.0 - 19.5' (cont) 30% fluid loss; light brown, brown-gray 15.5' 16.0' Dark gray
18.0				2.7/4.5	
20.0		19.4 ' Bornite on fracture face of mechanical break 20.2 - 20.3' Possible shear, 100% fragments .1" - .8"; 35° dip 20.8' - 21.1' Mylonite 21.1' 1" green C_aCO_3 vein		HQ	19.5 - 23.0' 28 min. RQD: 50% 30-40% fluid loss, 22.5 - 23.0' Light gray
22.0	Dcgs			3.3/3.5	
		23.0 - 24.9' Weak foliation, dipping 30°		HQ	23.0' Blocked off 23.0 - 25.0' 8 min. RQD: 70% 30-40% fluid loss
24.0		24.9 - 25.0' Mylonite		1.7/2.0	
					Total Depth= 25.0' Hole backfilled with bentonite-cement grout
26.0					

DWR 885 (2) (Rev. 9-84)

State of California
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DEPARTMENT OF WATER RESOURCES

SHEET 1 of 2

TEST PIT NO. TH #4

ELEV. 564.6 FEET

DEPTH 12.5 FEET

TEST PIT LOG

PROJECT Saeltzer Dam Fish Passage Project

DATE EXCAVATED 11/3/97

FEATURE Proposed Upstream Dam Site

ATTITUDE Vertical

LOCATION 135' SE of CCSL-9, Phone 1

LOGGED BY B. Lamkin

CONTR. U.S. BLM

EQUIPMENT Caterpillar 416B backhoe

DEPTH TO WATER 11.0' stabilized

BB= Backhoe Bucket

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	SM	STREAM TERRACE DEPOSITS 0.0 - 1.0' Silty Sand (SM): About 65% fine to medium sand, loose; about 20-25% non-plastic fines; about 10-15% fine to coarse, subangular to rounded gravel up to 2.5"; light to medium brown; slightly moist to moist			Excavation characteristics: 0.0 - 4.0' Easy 4.0 - 12.5' Moderate to difficult
2.0	(SP)g,c	1.0 - 4.0' Poorly Graded Sand with Gravel and Cobbles (SP)g,c: About 55% fine to coarse sand, compact; about 30-35% fine to coarse, subangular to subrounded gravel up to 3.0"; about 10-15% non-plastic fines; dry to slightly moist; light brown to reddish brown; total sample (by volume): about 10% hard to very hard, subangular to rounded cobbles up to .8'	A	BB	3.5 - 5.5' Backhoe bucket sample, approximately 3 gallons
4.0					
(560.0)	(GP)s,c	4.0 - 12.5' Poorly Graded Gravel with Sand and Cobbles (SP)g,c: About 55% fine to coarse sand, compact; about 30-35% fine to coarse, subangular to subrounded gravel up to 3.0"; slightly moist; light brown to reddish brown; total sample (by volume): about 10% hard to very hard, subangular to rounded cobbles up to .8'			8.0' Sporadic pockets of wet material
6.0					
8.0					
10.0		4.0 - 12.5' Poorly Graded Gravel with Sand and Cobbles (GP)s,c: About 70% fine to coarse, subangular to subrounded gravel up to 3.0"; about 30% fine to coarse sand; trace of fines; yellow to medium brown; slightly moist to wet, total sample (by volume): about 40% hard to very hard, subrounded to rounded cobbles up to .9'	B	BB	10.0 - 11.0' Backhoe bucket sample, approximately 3 gallons 11.0' Stabilized water 12.2' Water encountered 12.5' Bucket refusal
12.0	(GP)s,c	8.0' Minor wet spots 12.2' Water, saturated conditions			Total Depth= 12.5' Excavation backfilled with spoil material
14.0					
16.0					

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

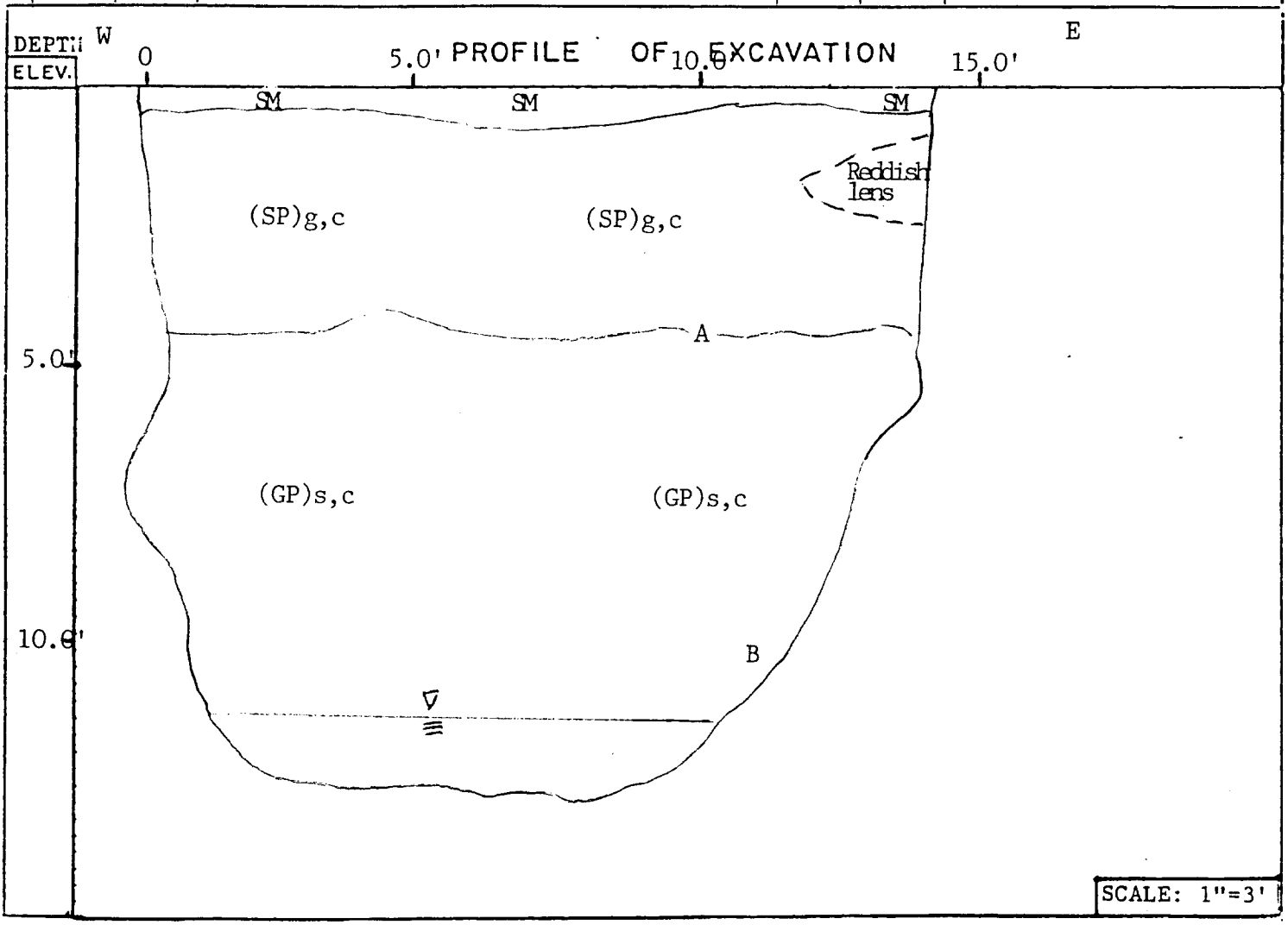
TEST PIT LOG

SHEET 2 OF 2

HOLE NO. TH #4

PROJECT & FEATURE Saeltzer Dam Fish Passage Project; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS



SCALE: 1"=3'

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

SHEET 1 of 2

TEST PIT LOG

TEST PIT NO. TH #5
ELEV. 565.6 FEET
DEPTH 14.0 FEET

PROJECT Saeltzer Dam Fish Passage Project
DATE EXCAVATED 11/3/97
FEATURE Proposed Upstream Dam Site
ATTITUDE Vertical
LOCATION CCSL-6, Phone 17
LOGGED BY B. Lamkin
CONTR. U.S. BLM
EQUIPMENT Caterpillar 416B Backhoe
DEPTH TO WATER 10.5' stabilize

BB= Backhoe Bucket

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS
0.0	SM	STREAM TERRACE DEPOSITS 0.0 - 1.0' Silty Sand (SM): About 70% fine to coarse sand, loose; about 20% non-plastic fines; about 10% fine gravel; gray-brown; slightly moist			Excavation characteristics: 0.0 - 4.5' Easy
2.0	(SP)g	1.0 - 3.0' Poorly Graded Sand with Gravel (SP)g: About 70% fine to coarse sand, loose; about 20-25% fine to coarse, subangular to subrounded gravel up to 2.5"; about 5-10% non-plastic fines; gray-brown; moist			4.5 - 14.0' Moderately difficult
4.0	SM	3.0 - 4.5' Silty Sand (SM): About 70% fine to medium sand, about 10% coarse sand, loose; about 20% non-plastic fines; gray-brown; slightly moist	A	BB	4.0 - 5.5' Backhoe bucket sample approximately 3 gallons
(560.0)	(GP)s,c	4.5 - 14.0' Poorly Graded Gravel with Sand and Cobbles (GP)s,c: About 55% fine to coarse, subangular to subrounded gravel up to 3.0"; about 40-45% fine to coarse sand, compact to dense; about 0-5% non-plastic fines; gray-brown; moist to wet			
6.0					
8.0		Total sample (by volume): about 5-15% hard to very hard, subangular to rounded cobbles up to .8'	B	BB	8.5 - 10.0' Backhoe bucket sample approximately 3 gallons
10.0					10.5' Stabilized water
	(GP)s,c	11.0 - 14.0' Southeast corner, concentration of cobbles (80%) up to .8'			
12.0		12.0' Water (saturated conditions)			12.0' Water first encountered
14.0					Total Depth= 14.0' Hole backfilled with spoil
16.0					

DWR 885 (1) (Rev. 9-84)

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

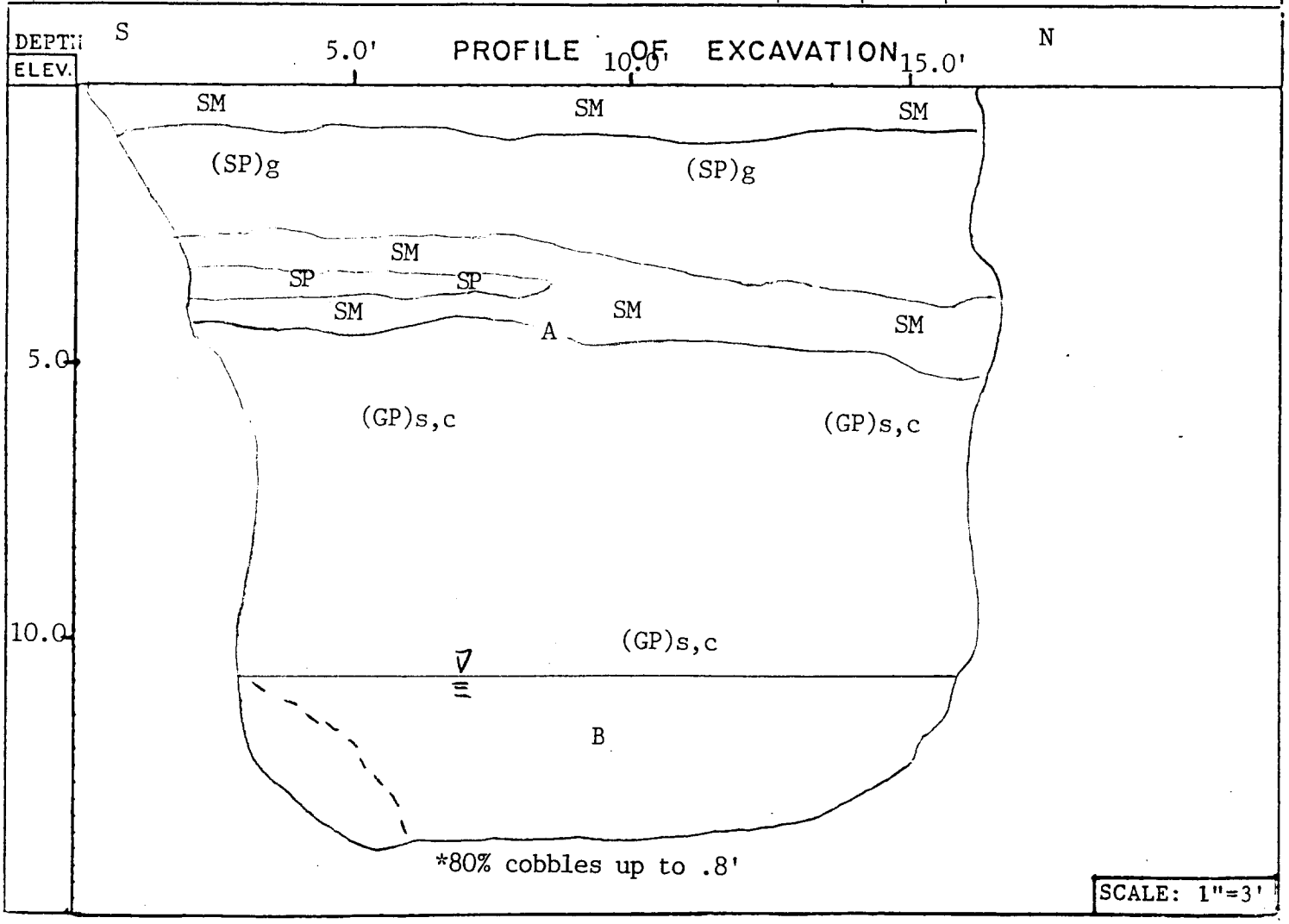
TEST PIT LOG

SHEET 2 OF 2

HOLE NO. TH #5

PROJECT & FEATURE Saeltzer Dam Fish Passage; Proposed Upstream Dam Site

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	SAMPLE NO.	MODE	REMARKS



APPENDIX B

SEISMIC REFRACTION DATA

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 1

Phone Spacing: 5' Bearing: N 25 W

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	563.8	785.0	15263.0	10.00	553.8
1	0	564.3	785.0	15263.0	10.70	553.6
2	5	564.1	785.0	15263.0	10.60	553.5
3	10	563.2	785.0	15263.0	9.80	553.4
4	15	562.1	785.0	15263.0	8.80	553.3
5	20	561.8	785.0	15263.0	8.60	553.2
6	25	561.6	785.0	15263.0	8.50	553.1
7	30	561.4	785.0	15263.0	8.40	553.0
8	35	561.2	785.0	15263.0	8.20	553.0
9	40	561.0	785.0	15263.0	8.10	552.9
10	45	561.0	785.0	15263.0	8.20	552.8
11	50	561.2	785.0	15263.0	8.50	552.7
12	55	561.4	785.0	15263.0	8.80	552.6
13	60	561.6	785.0	15263.0	9.10	552.5
14	65	561.8	785.0	15263.0	9.40	552.4
15	70	562.0	785.0	15263.0	9.70	552.3
16	75	562.8	785.0	15263.0	10.60	552.2
17	80	563.6	785.0	15263.0	11.40	552.2
18	85	564.2	785.0	15263.0	12.10	552.1
19	90	564.6	785.0	15263.0	12.60	552.0
20	95	565.0	785.0	15263.0	13.10	551.9
21	100	565.3	785.0	15263.0	13.50	551.8
22	105	565.6	785.0	15263.0	13.90	551.7
23	110	565.3	785.0	15263.0	13.70	551.6
24	115	565.0	785.0	15263.0	13.50	551.5
SP+15	130	563.4	785.0	15263.0	12.50	550.9

** error factor +- 2.5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File: CCSL1002.TX

Header data from file CCSL1002.

File number:	CCSL1002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0902971303
Operator note:	SHOT POINT -15', PHONE SPACE 5', GRAVELS & COBBLES
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	563.8

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 1

Phone Spacing: 5' Bearing: N 25 W

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	563.8	785.0	15263.0	10.00	553.8
1	0	564.3	785.0	15263.0	10.70	553.6
2	5	564.1	785.0	15263.0	10.60	553.5
3	10	563.2	785.0	15263.0	9.80	553.4
4	15	562.1	785.0	15263.0	8.80	553.3
5	20	561.8	785.0	15263.0	8.60	553.2
6	25	561.6	785.0	15263.0	8.50	553.1
7	30	561.4	785.0	15263.0	8.40	553.0
8	35	561.2	785.0	15263.0	8.20	553.0
9	40	561.0	785.0	15263.0	8.10	552.9
10	45	561.0	785.0	15263.0	8.20	552.8
11	50	561.2	785.0	15263.0	8.50	552.7
12	55	561.4	785.0	15263.0	8.80	552.6
13	60	561.6	785.0	15263.0	9.10	552.5
14	65	561.8	785.0	15263.0	9.40	552.4
15	70	562.0	785.0	15263.0	9.70	552.3
16	75	562.8	785.0	15263.0	10.60	552.2
17	80	563.6	785.0	15263.0	11.40	552.2
18	85	564.2	785.0	15263.0	12.10	552.1
19	90	564.6	785.0	15263.0	12.60	552.0
20	95	565.0	785.0	15263.0	13.10	551.9
21	100	565.3	785.0	15263.0	13.50	551.8
22	105	565.6	785.0	15263.0	13.90	551.7
23	110	565.3	785.0	15263.0	13.70	551.6
24	115	565.0	785.0	15263.0	13.50	551.5
SP+15	130	563.4	785.0	15263.0	12.50	550.9

** error factor +- 2.5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File: CCSL1002.TX

Header data from file CCSL1002.

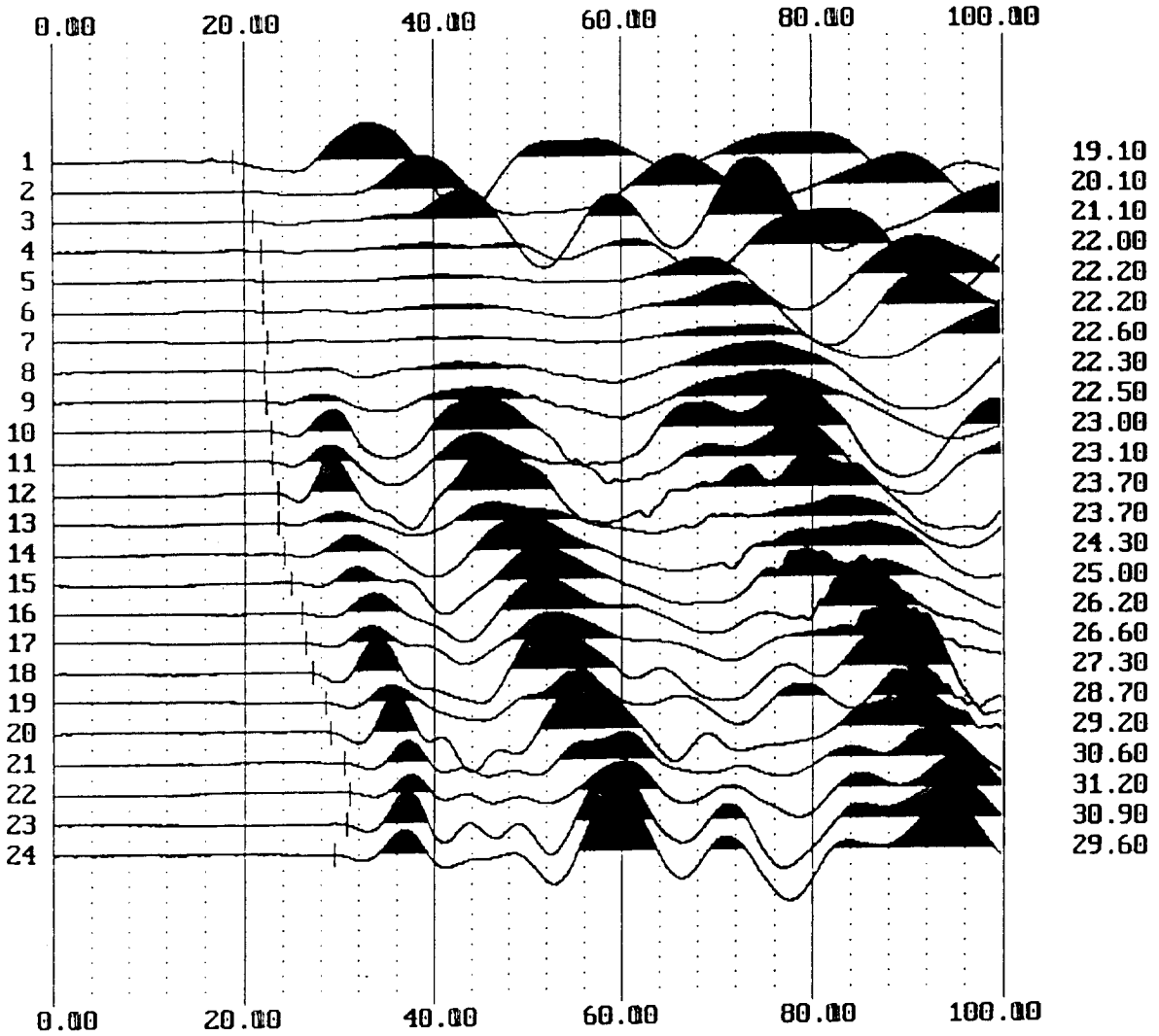
File number:	CCSL1002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0902971303
Operator note:	SHOT POINT -15', PHONE SPACE 5', GRAVELS & COBBLES
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	563.8

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL1002.TXE

Seismic waveform data from file CCSL1002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File: CCSL1002.TX

First Arrival and Elevation Data from CCSL1002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	563.80	-15.00	
1	564.30	0.00	19.10
2	564.10	5.00	20.10
3	563.20	10.00	21.10
4	562.10	(15.00)	22.00
5	561.80	(20.00)	22.20
6	561.60	(25.00)	22.20
7	561.40	(30.00)	22.60
8	561.20	(35.00)	22.30
9	561.00	(40.00)	22.50
10	561.00	(45.00)	23.00
11	561.20	(50.00)	23.10
12	561.40	(55.00)	23.70
13	561.60	(60.00)	23.70
14	561.80	(65.00)	24.30
15	562.00	(70.00)	25.00
16	562.80	(75.00)	26.20
17	563.60	(80.00)	26.60
18	564.20	(85.00)	27.30
19	564.60	(90.00)	28.70
20	565.00	(95.00)	29.20
21	565.30	(100.00)	30.60
22	565.60	(105.00)	31.20
23	565.30	(110.00)	30.90
24	565.00	(115.00)	29.60

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL1005.TXE

Header data from file CCSL1005.

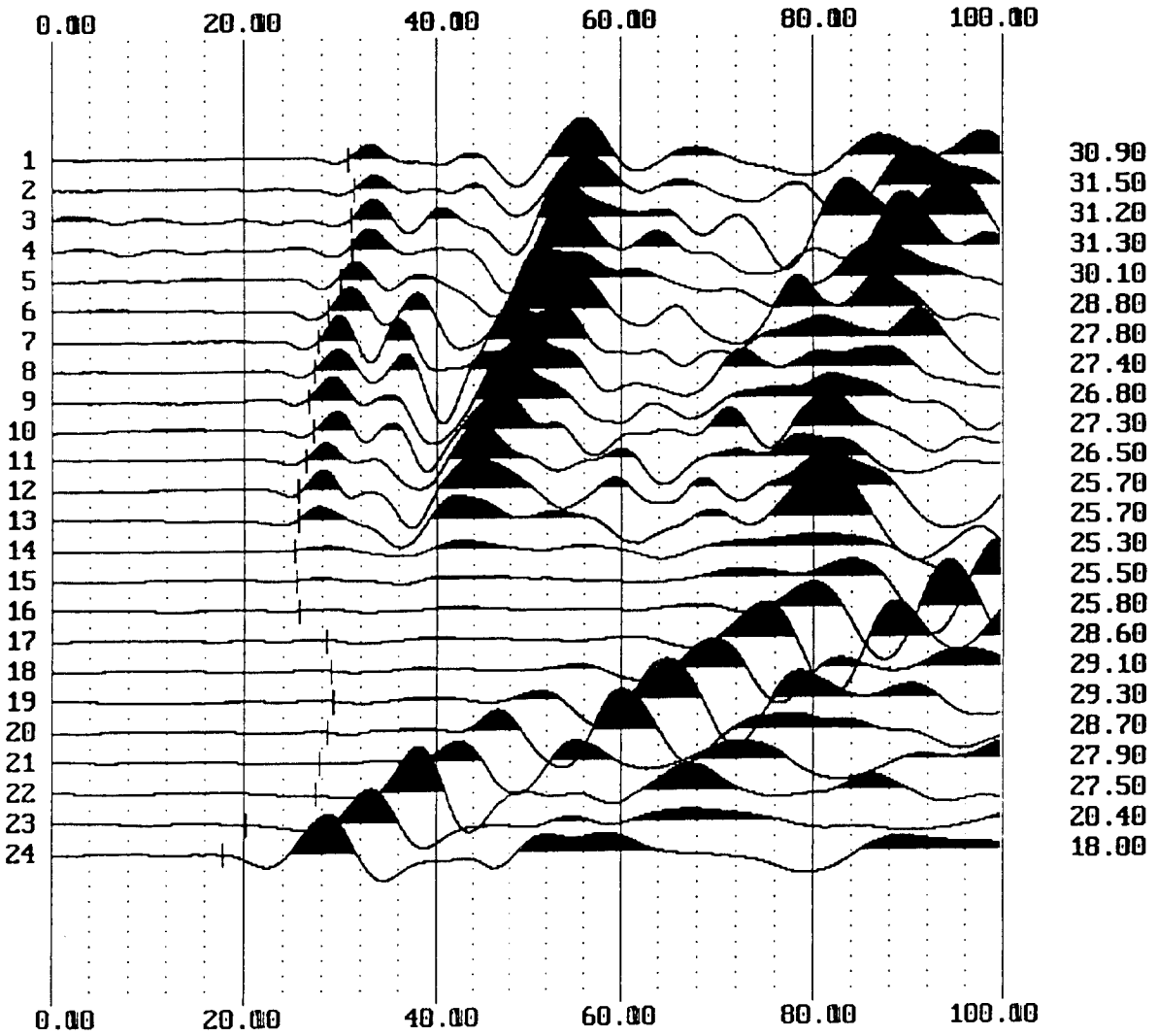
File number:	CCSL1005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0902971314
Operator note:	SHOT POINT 130', PHONE SPACE 5', GRAVELS & COBBLES
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	130.0
Shot location Y:	0.0
Shot location Z:	563.4

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL1005.TXF

Seismic waveform data from file CCSL1005.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL1005.TXE

First Arrival and Elevation Data from CCSL1005.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	563.40	130.00	
1	564.30	0.00	30.90
2	564.10	5.00	31.50
3	563.20	10.00	31.20
4	562.10	(15.00)	31.30
5	561.80	(20.00)	30.10
6	561.60	(25.00)	28.80
7	561.40	(30.00)	27.80
8	561.20	(35.00)	27.40
9	561.00	(40.00)	26.80
10	561.00	(45.00)	27.30
11	561.20	(50.00)	26.50
12	561.40	55.00	25.70
13	561.60	60.00	25.70
14	561.80	65.00	25.30
15	562.00	70.00	25.50
16	562.80	75.00	25.80
17	563.60	80.00	28.60
18	564.20	85.00	29.10
19	564.60	(90.00)	29.30
20	565.00	(95.00)	28.70
21	565.30	(100.00)	27.90
22	565.60	(105.00)	27.50
23	565.30	(110.00)	20.40
24	565.00	(115.00)	18.00

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	920	20776
Dip Angle:	-0.16	-1.18
Averaging Interval:	0- 144	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	563.8	10.0
1	15.0	564.3	10.7
2	20.0	564.1	10.6
3	25.0	563.2	9.8
4	30.0	562.1	8.8
5	35.0	561.8	8.6
6	40.0	561.6	8.5
7	45.0	561.4	8.4
8	50.0	561.2	8.2
9	55.0	561.0	8.1
10	60.0	561.0	8.2
11	65.0	561.2	8.5
12	70.0	561.4	8.8
13	75.0	561.6	9.1
14	80.0	561.8	9.4
15	85.0	562.0	9.7
16	90.0	562.8	10.6
17	95.0	563.6	11.4
18	100.0	564.2	12.1
19	105.0	564.6	12.6
20	110.0	565.0	13.1
21	115.0	565.3	13.5
22	120.0	565.6	13.9
23	125.0	565.3	13.7
24	130.0	565.0	13.5
Rev Shot	0.0	563.4	12.5

CLEAR CREEK SEISMIC SURVEY

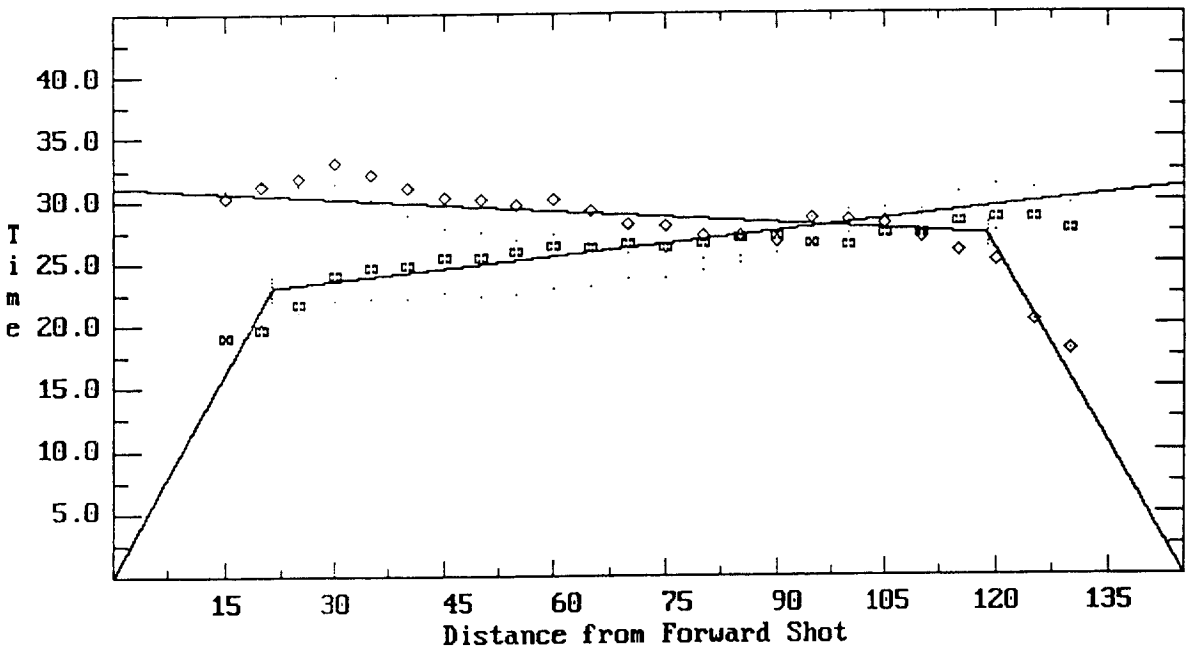
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL1002.TXE	CCSL1005.TXE
Shot Pos:	-15.0	130.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL1002.TXE	CCSL1005.TXE
Shot Pos:	-15.0	130.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	920	161	0.0	4	0.0
Forward	2	15518	>E3	21.6	0	21.1
Reverse	1	956	173	0.0	4	0.0
Reverse	2	31437	>E3	26.4	0	26.0

CLEAR CREEK SEISMIC SURVEY

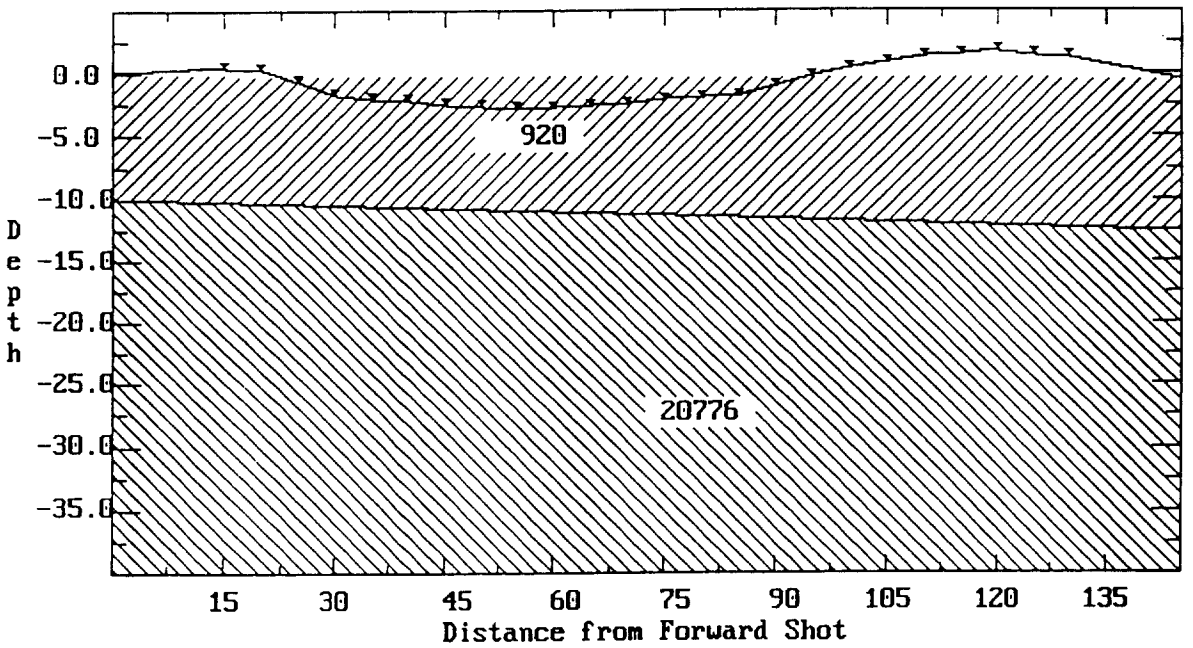
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL1002.TXE	CCSL1005.TXE
Shot Pos:	-15.0	130.0

Depth Profile Plot for



Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 1

Phone Spacing: 5' Bearing: N 25 W

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-5	-5	564.5	785.0	15263.0	8.25	556.3
1	0	564.3	785.0	15263.0	8.87	555.4
2	5	564.1	785.0	15263.0	8.71	555.4
3	10	563.2	785.0	15263.0	7.84	555.4
4	15	562.1	785.0	15263.0	6.78	555.3
5	20	561.8	785.0	15263.0	6.52	555.3
6	25	561.6	785.0	15263.0	6.63	555.0
7	30	561.4	785.0	15263.0	6.20	555.2
8	35	561.2	785.0	15263.0	6.04	555.2
9	40	561.0	785.0	15263.0	5.88	555.1
10	45	561.0	785.0	15263.0	5.92	555.1
11	50	561.2	785.0	15263.0	6.16	555.0
12	55	561.4	785.0	15263.0	6.40	555.0
13	60	561.6	785.0	15263.0	6.64	555.0
14	65	561.8	785.0	15263.0	6.88	554.9
15	70	562.0	785.0	15263.0	7.12	554.9
16	75	562.8	785.0	15263.0	7.96	554.8
17	80	563.6	785.0	15263.0	8.80	554.8
18	85	564.2	785.0	15263.0	9.44	554.8
19	90	564.6	785.0	15263.0	9.88	554.7
20	95	565.0	785.0	15263.0	10.32	554.7
21	100	565.3	785.0	15263.0	10.66	554.6
22	105	565.6	785.0	15263.0	11.00	554.6
23	110	565.3	785.0	15263.0	10.74	554.6
24	115	565.0	785.0	15263.0	10.48	554.5
SP+5	120	564.6	785.0	15263.0	10.02	554.6

** error factor +- 2.5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Header data from file CCSL1001.

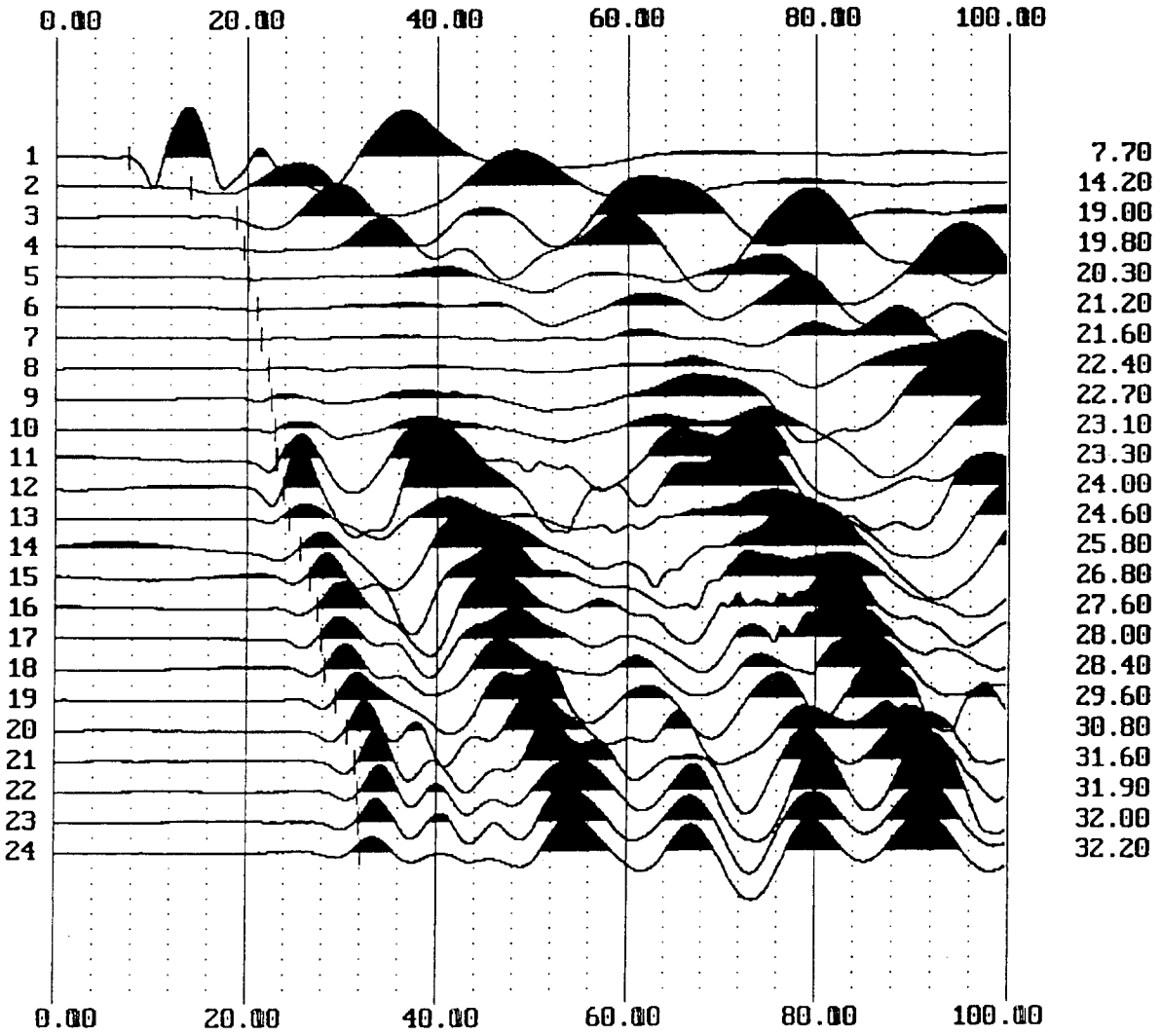
File number:	SEISMIC LINE CCSL-1
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0902971257
Operator note:	SHOT POINT -5 FEET, PHONE SPACING 5 FEET
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	0.0
Shot location Y:	0.0
Shot location Z:	0.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Seismic waveform data from file CCSL1001.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

First Arrival and Elevation Data from

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	564.50	-5.00	
1	564.30	(0.00)	7.70
2	564.10	5.00	14.20
3	563.20	10.00	19.00
4	562.10	(15.00)	19.80
5	561.80	(20.00)	20.30
6	561.60	(25.00)	21.20
7	561.40	(30.00)	21.60
8	561.20	(35.00)	22.40
9	561.00	(40.00)	22.70
10	561.00	(45.00)	23.10
11	561.20	(50.00)	23.30
12	561.40	(55.00)	24.00
13	561.60	(60.00)	24.60
14	561.80	(65.00)	25.80
15	562.00	(70.00)	26.80
16	562.80	(75.00)	27.60
17	563.60	(80.00)	28.00
18	564.20	(85.00)	28.40
19	564.60	(90.00)	29.60
20	565.00	(95.00)	30.80
21	565.30	(100.00)	31.60
22	565.60	(105.00)	31.90
23	565.30	(110.00)	32.00
24	565.00	(115.00)	32.20

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Header data from file CCSL1004.

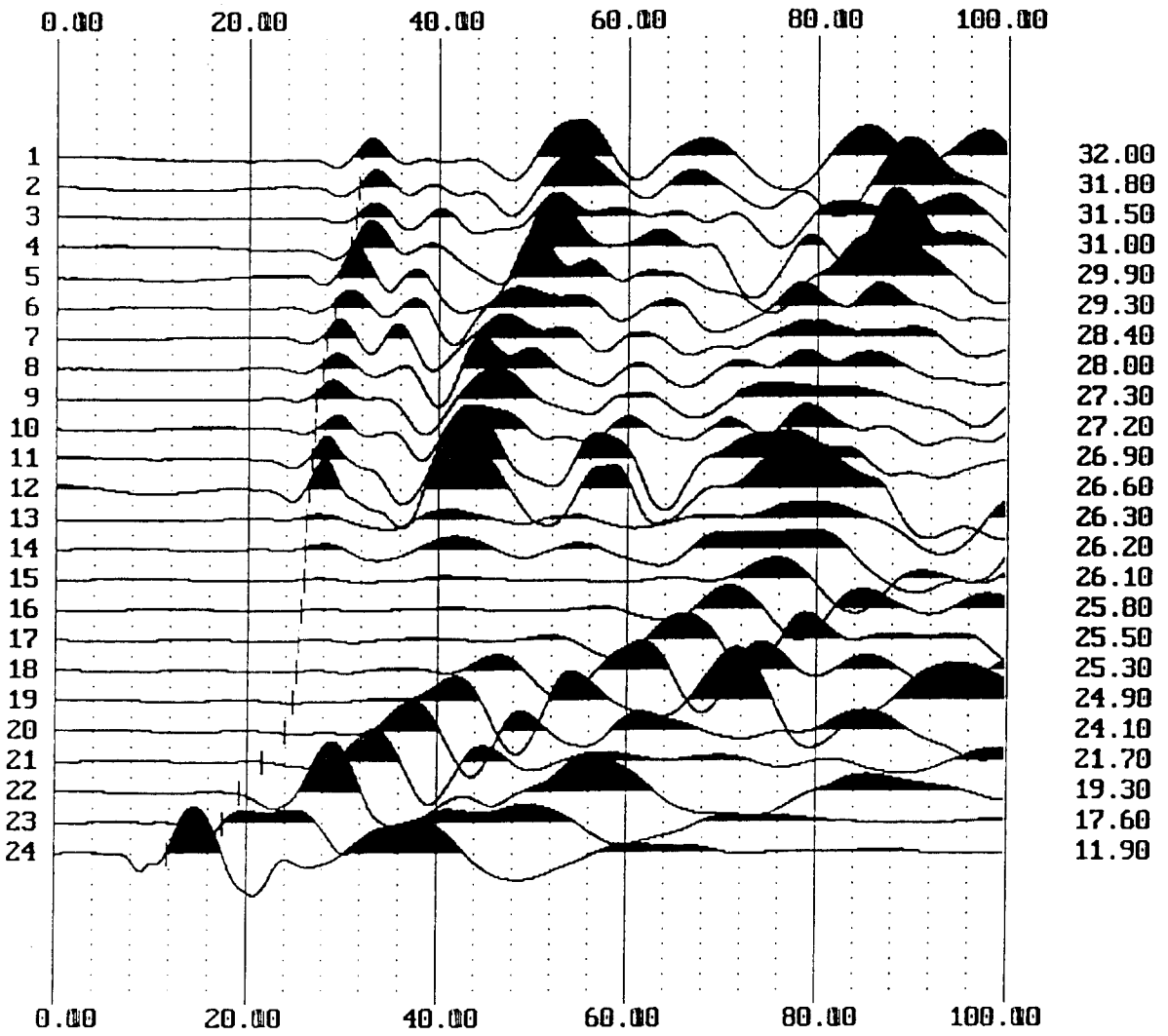
File number:	SEISMIC LINE CCSL-1
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0902971311
Operator note:	SHOT POINT 120 FEET, PHONE SPACING 5 FEET
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	120.0
Shot location Y:	0.0
Shot location Z:	0.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Seismic waveform data from file CCSL1004.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File:

First Arrival and Elevation Data from

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	564.50	120.00	
1	564.30	0.00	32.00
2	564.10	5.00	31.80
3	563.20	10.00	31.50
4	562.10	(15.00)	31.00
5	561.80	(20.00)	29.90
6	561.60	(25.00)	29.30
7	561.40	(30.00)	28.40
8	561.20	(35.00)	28.00
9	561.00	(40.00)	27.30
10	561.00	(45.00)	27.20
11	561.20	(50.00)	26.90
12	561.40	(55.00)	26.60
13	561.60	(60.00)	26.30
14	561.80	(65.00)	26.20
15	562.00	(70.00)	26.10
16	562.80	(75.00)	25.80
17	563.60	(80.00)	25.50
18	564.20	(85.00)	25.30
19	564.60	(90.00)	24.90
20	565.00	(95.00)	24.10
21	565.30	(100.00)	21.70
22	565.60	(105.00)	19.30
23	565.30	(110.00)	17.60
24	565.00	(115.00)	11.90

CLEAR CREEK SEISMIC SURVEY

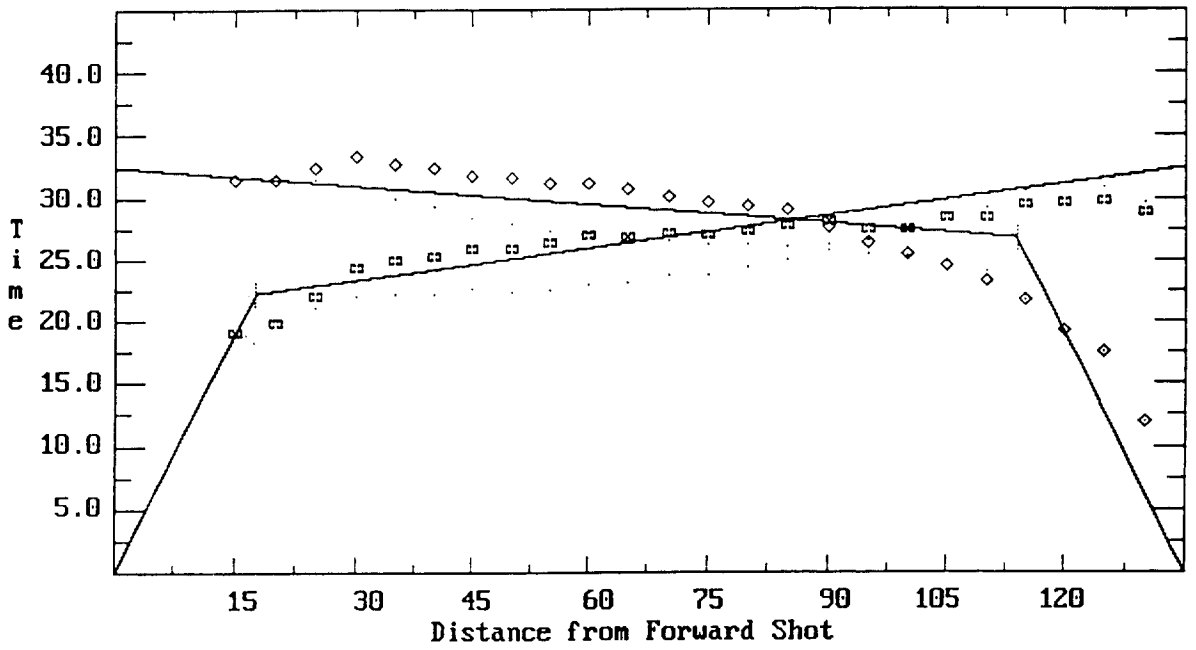
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL1002.TXE	CCSL1004.TXE
Shot Pos:	-15.0	120.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL1002.TXE	CCSL1004.TXE
Shot Pos:	-15.0	120.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	785	160	0.0	5	0.0
Forward	2	11556	923	20.7	1	17.5
Reverse	1	782	158	0.0	5	0.0
Reverse	2	20017	>E3	25.7	1	20.9

CLEAR CREEK SEISMIC SURVEY

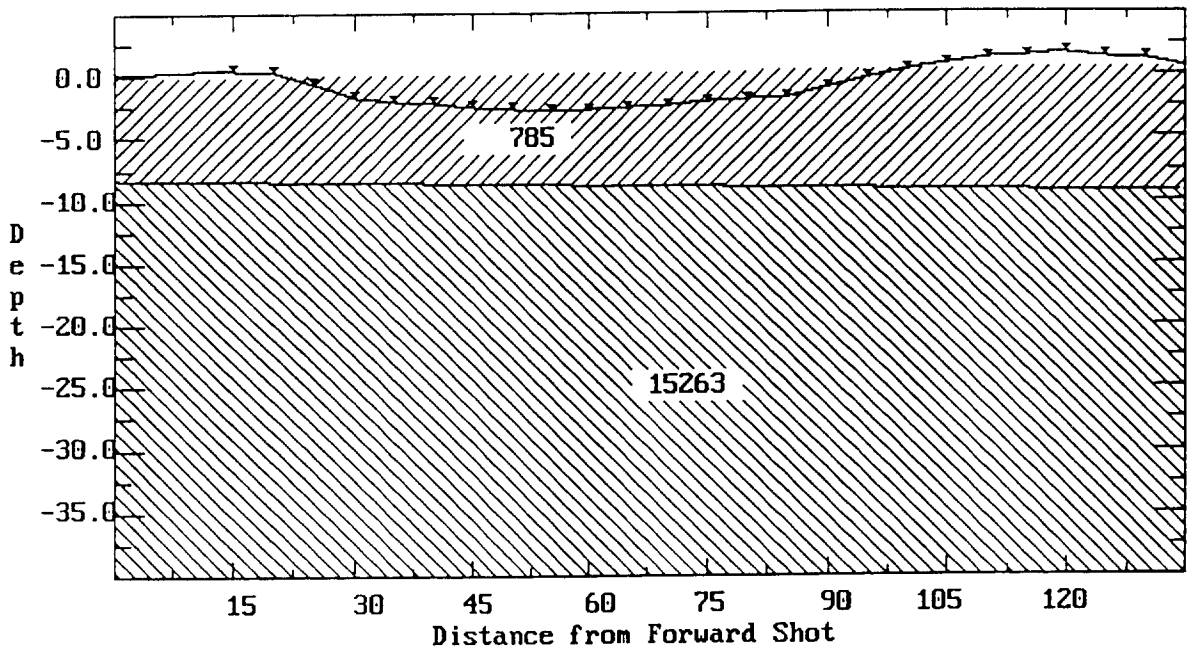
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL1002.TXE	CCSL1004.TXE
Shot Pos:	-15.0	120.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	785	15263
Dip Angle:	0.30	-0.16
Averaging Interval:	0- 134	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	563.8	8.2
1	15.0	564.3	8.9
2	20.0	564.1	8.7
3	25.0	563.2	7.8
4	30.0	562.1	6.8
5	35.0	561.8	6.5
6	40.0	561.6	6.4
7	45.0	561.4	6.2
8	50.0	561.2	6.0
9	55.0	561.0	5.9
10	60.0	561.0	5.9
11	65.0	561.2	6.2
12	70.0	561.4	6.4
13	75.0	561.6	6.6
14	80.0	561.8	6.9
15	85.0	562.0	7.1
16	90.0	562.8	8.0
17	95.0	563.6	8.8
18	100.0	564.2	9.4
19	105.0	564.6	9.9
20	110.0	565.0	10.3
21	115.0	565.3	10.7
22	120.0	565.6	11.0
23	125.0	565.3	10.7
24	130.0	565.0	10.5
Rev Shot	0.0	564.5	9.3

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 2

Phone Spacing: 5' Bearing: N 10 W

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-5	-5	565.0	870.0	13000.0	8.48	556.5
1	0	564.3	870.0	13000.0	8.37	555.9
2	5	564.1	870.0	13000.0	8.28	555.8
3	10	563.9	870.0	13000.0	8.19	555.7
4	15	563.5	870.0	13000.0	7.90	555.6
5	20	562.9	870.0	13000.0	7.41	555.5
6	25	562.2	870.0	13000.0	6.82	555.4
7	30	560.5	870.0	13000.0	5.23	555.3
8	35	558.2	870.0	13000.0	3.04	555.2
9	40	557.8	870.0	13000.0	2.75	555.1
10	45	557.6	870.0	13000.0	2.66	554.9
SP+5	50	556.8	870.0	13000.0	2.57	554.2

** error factor +- 2.5feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Header data from file CCSL2001.

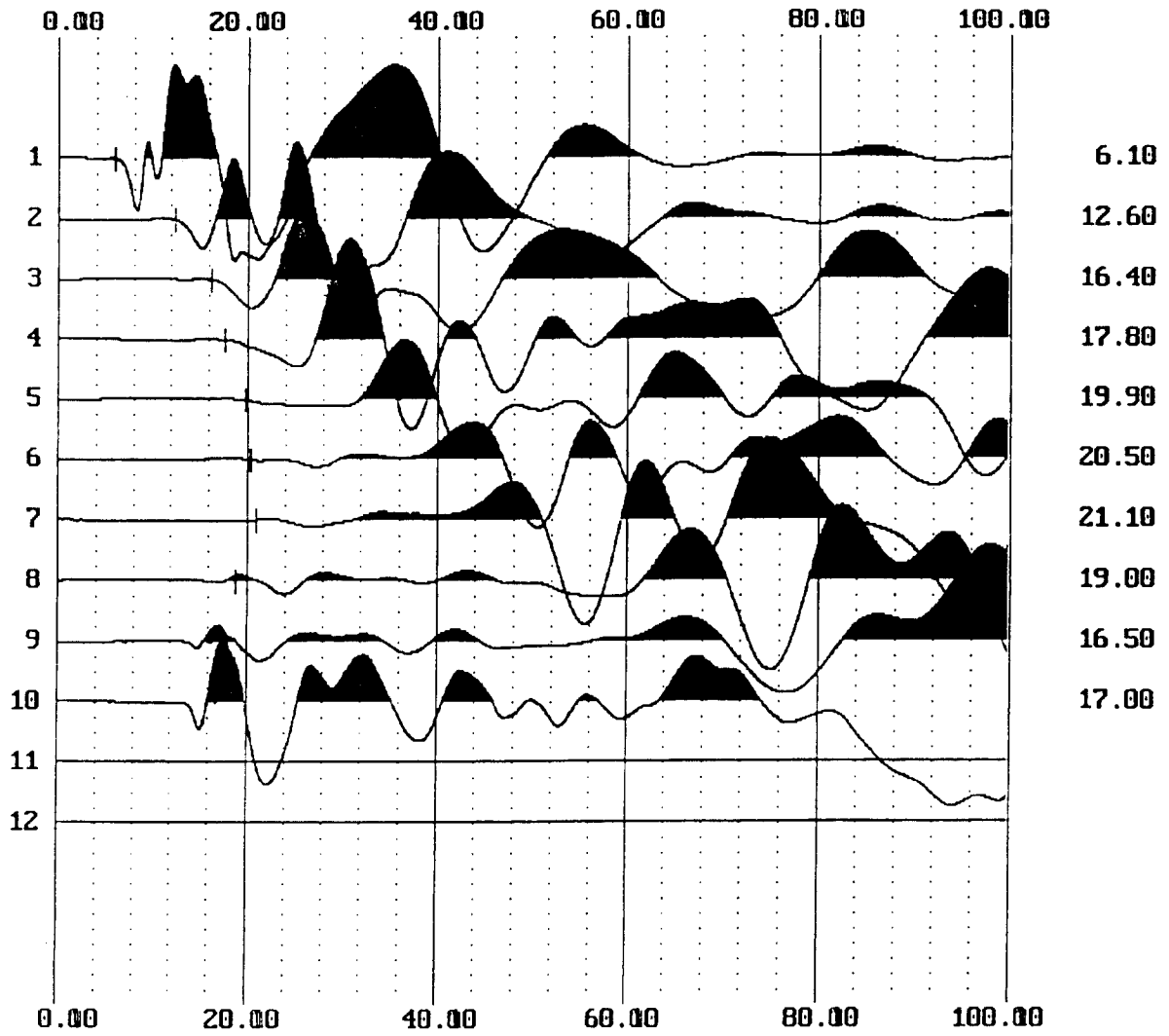
File number:	CCSL2001
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0902971405
Operator note:	SHOT POINT -5 FEET, PHONE SPACING 5 FEET, 10 CHANNELS
Manufacturer code:	BISON-2
Number of channels:	10
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-5.0
Shot location Y:	0.0
Shot location Z:	0.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Seismic waveform data from file CCSL2001.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

First Arrival and Elevation Data from

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	564.60	-5.00	
1	564.30	0.00	6.10
2	564.10	5.00	12.60
3	563.90	10.00	16.40
4	563.50	(15.00)	17.80
5	562.90	(20.00)	19.90
6	562.20	(25.00)	20.50
7	560.50	(30.00)	21.10
8	558.20	(35.00)	19.00
9	557.80	(40.00)	16.50
10	557.60	(45.00)	17.00

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Header data from file CCSL2003.

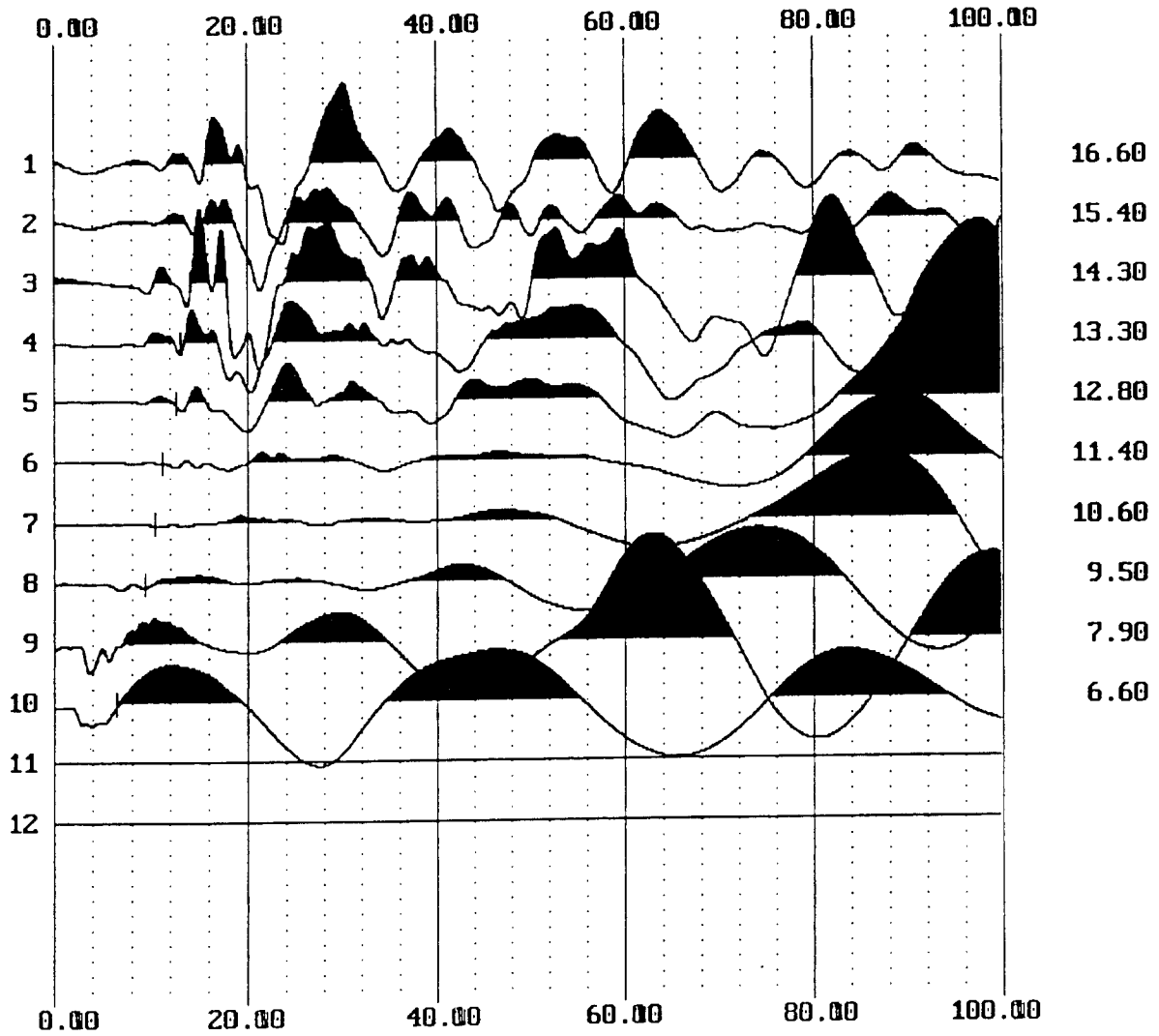
File number:	CCSL2004
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0902971411
Operator note:	SHOT POINT 50 FEET, PHONE SPACING 5 FEET, 10 CHANNELS
Manufacturer code:	BISON-2
Number of channels:	10
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	50.0
Shot location Y:	0.0
Shot location Z:	0.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Seismic waveform data from file CCSL2003.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

First Arrival and Elevation Data from

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	557.40	50.00	
1	564.30	0.00	16.60
2	564.10	5.00	15.40
3	563.90	10.00	14.30
4	563.50	(15.00)	13.30
5	562.90	(20.00)	12.80
6	562.20	(25.00)	11.40
7	560.50	(30.00)	10.60
8	558.20	(35.00)	9.50
9	557.80	(40.00)	7.90
10	557.60	(45.00)	6.60

CLEAR CREEK SEISMIC SURVEY

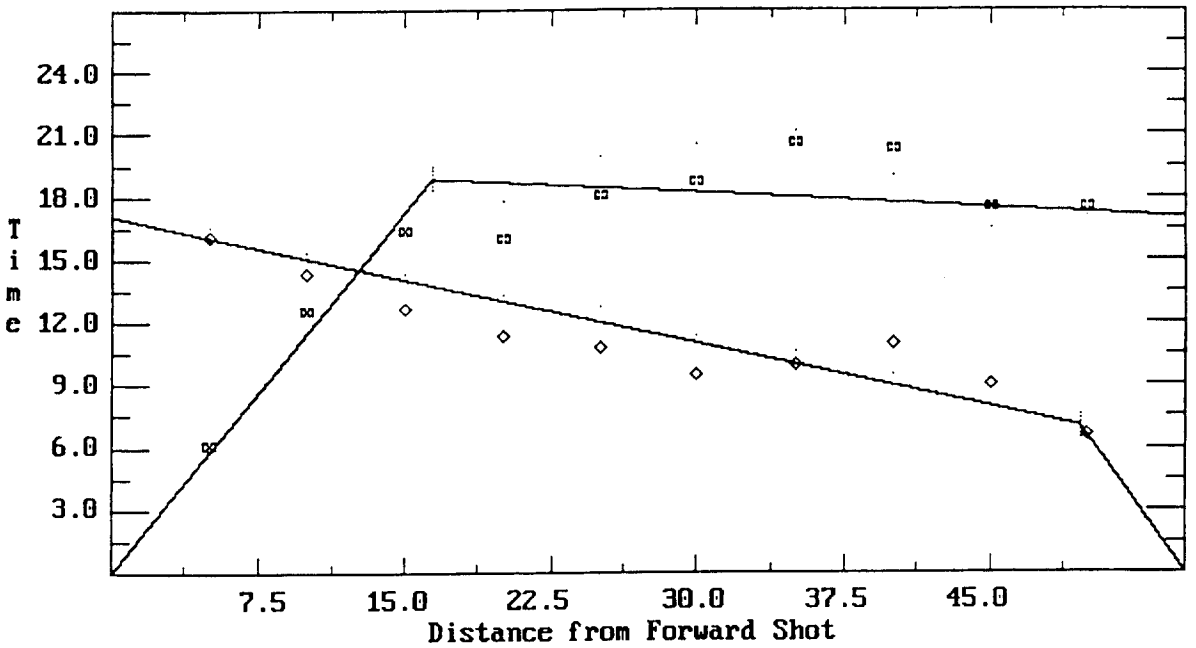
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL2001.TXE	CCSL2003.TXE
Shot Pos:	-5.0	50.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL2001.TXE	CCSL2003.TXE
Shot Pos:	-5.0	50.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	870	61	0.0	1	0.0
Forward	2	-20594	>E3	19.7	1	16.4
Reverse	1	758	47	0.0	1	0.0
Reverse	2	4959	654	5.9	1	5.3

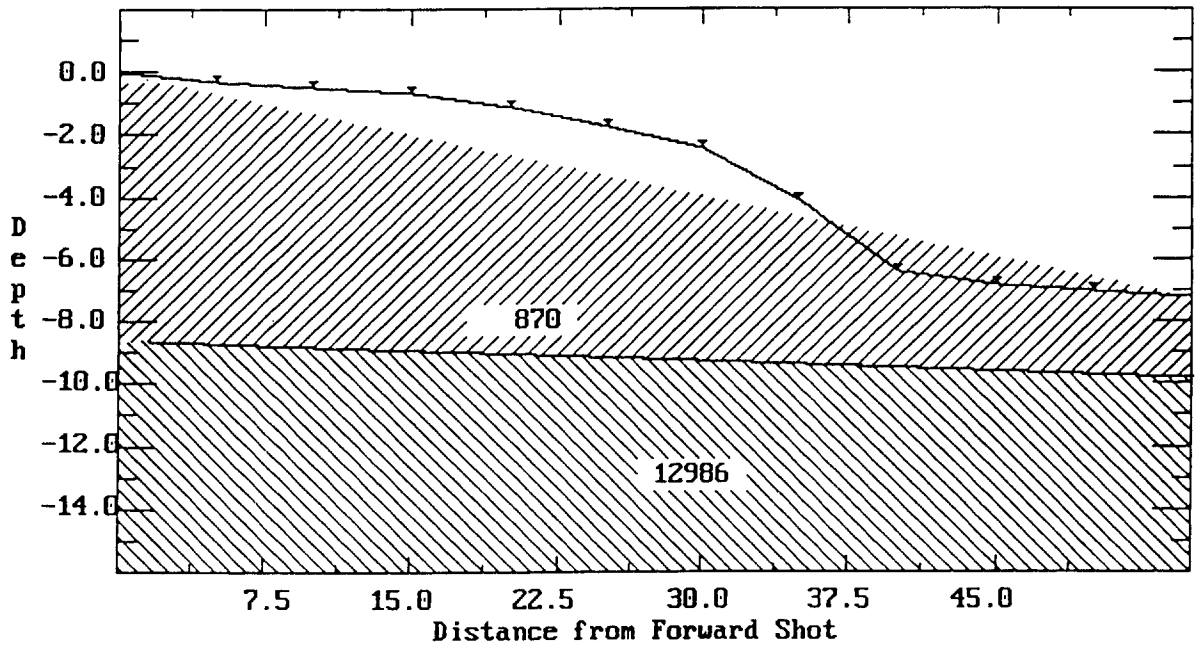
CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL2001.TXE	CCSL2003.TXE
Shot Pos:	-5.0	50.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	870	12986
Dip Angle:	-7.52	-8.78
Averaging Interval:	2- 55	

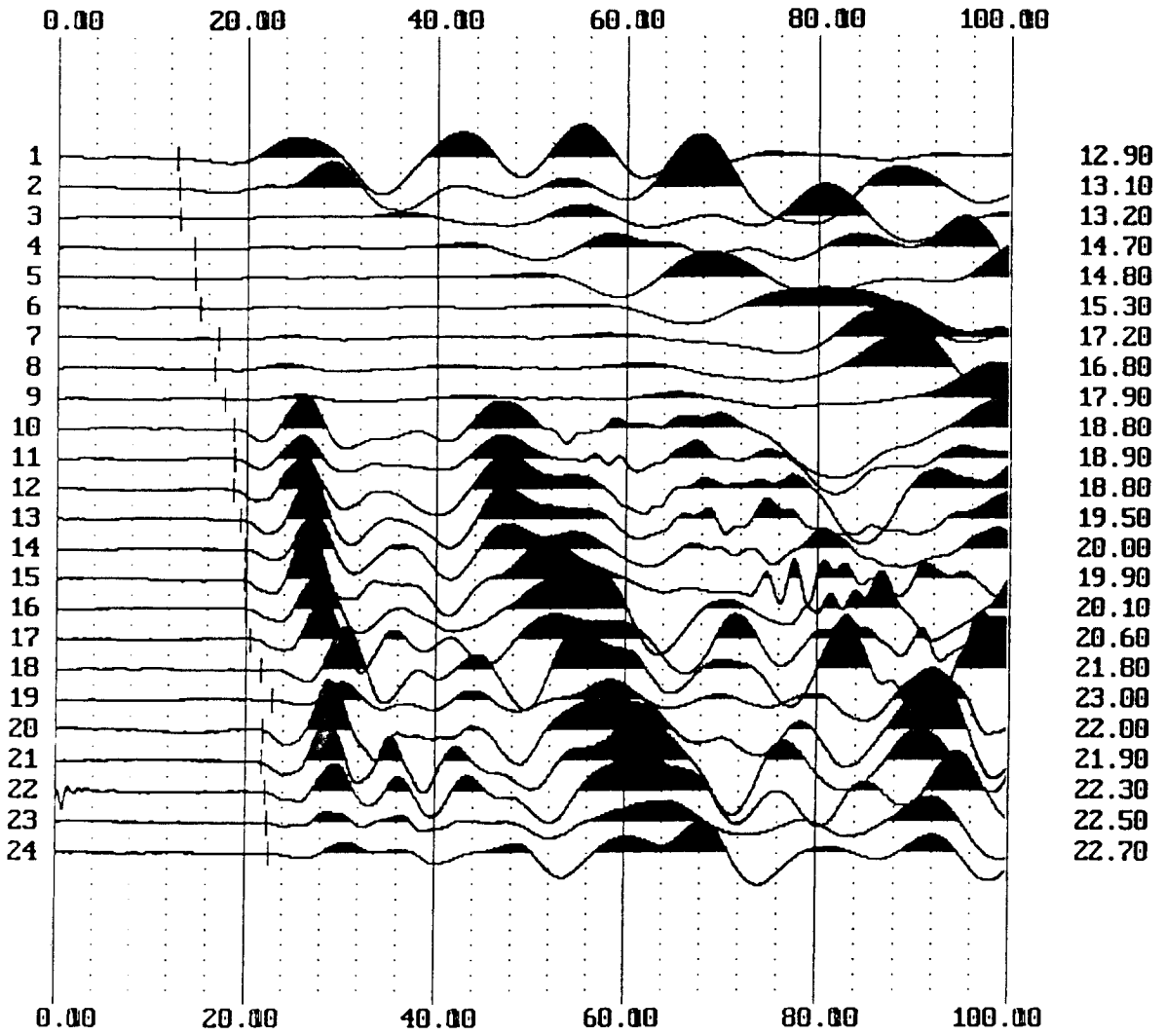
Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	564.6	8.5
1	5.0	564.3	8.4
2	10.0	564.1	8.3
3	15.0	563.9	8.2
4	20.0	563.5	7.9
5	25.0	562.9	7.4
6	30.0	562.2	6.8
7	35.0	560.5	5.2
8	40.0	558.2	3.0
9	45.0	557.8	2.7
10	50.0	557.6	2.7
Rev Shot	0.0	557.4	9.7

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL3-2.TXE

Seismic waveform data from file CCSL3002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL3-2.TXE

First Arrival and Elevation Data from CCSL3-2.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	567.70	-15.00	
1	566.70	0.00	12.90
2	566.20	5.00	13.10
3	565.80	10.00	13.20
4	565.70	(15.00)	14.70
5	566.20	(20.00)	14.80
6	566.30	(25.00)	15.30
7	566.40	(30.00)	17.20
8	566.60	(35.00)	16.80
9	566.80	(40.00)	17.90
10	567.00	(45.00)	18.80
11	567.20	(50.00)	18.90
12	567.40	(55.00)	18.80
13	567.60	(60.00)	19.50
14	567.90	(65.00)	20.00
15	568.20	(70.00)	19.90
16	568.80	(75.00)	20.10
17	568.00	(80.00)	20.60
18	567.80	(85.00)	21.80
19	567.70	(90.00)	23.00
20	567.90	(95.00)	22.00
21	568.40	(100.00)	21.90
22	568.20	(105.00)	22.30
23	567.60	(110.00)	22.50
24	567.00	(115.00)	22.70

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 3

Phone Spacing: 5' Bearing: N 61 W

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	567.7	1163.0	13681.0	6.66	561.0
1	0	566.7	1163.0	13681.0	6.51	560.2
2	5	566.2	1163.0	13681.0	6.29	559.9
3	10	565.8	1163.0	13681.0	6.17	559.6
4	15	565.7	1163.0	13681.0	6.36	559.3
5	20	566.2	1163.0	13681.0	7.14	559.1
6	25	566.3	1163.0	13681.0	7.52	558.8
7	30	566.4	1163.0	13681.0	7.91	558.5
8	35	566.6	1163.0	13681.0	8.39	558.2
9	40	566.8	1163.0	13681.0	8.87	557.9
10	45	567.0	1163.0	13681.0	9.35	557.7
11	50	567.2	1163.0	13681.0	9.84	557.4
12	55	567.4	1163.0	13681.0	10.32	557.1
13	60	567.6	1163.0	13681.0	10.80	556.8
14	65	567.9	1163.0	13681.0	11.39	556.5
15	70	568.2	1163.0	13681.0	11.97	556.2
16	75	568.8	1163.0	13681.0	12.85	556.0
17	80	568.0	1163.0	13681.0	12.33	555.7
18	85	567.8	1163.0	13681.0	12.42	555.4
19	90	567.7	1163.0	13681.0	12.60	555.1
20	95	567.9	1163.0	13681.0	13.08	554.8
21	100	568.4	1163.0	13681.0	13.87	554.5
22	105	568.2	1163.0	13681.0	13.95	554.3
23	110	567.6	1163.0	13681.0	13.63	554.0
24	115	567.0	1163.0	13681.0	13.32	553.7
SP+15	130	563.8	1163.0	13681.0	11.75	552.1

** error factor +- 2.5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL3-2.TXE

Header data from file CCSL3002.

File number:	CCSL3002
Job number:	CLEAR CREEK SEISMIC
Date and time:	0903971022
Operator note:	SHOT POINT -15', PHONE SPACING 5', LINE IN SAND
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	567.7

CLEAR CREEK SEISMIC STUDY,

ALTERNATE DAM SITE STUDY
SEISMIC LINE CHRSL-3
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCSL3-2.SPR

Depth Profile Summary for CCSL3-2.SPR

	Layer 1	Layer 2
Velocity:	1163	13681
Dip Angle:	-1.49	-4.73
Averaging Interval:	0- 149	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	567.7	6.7
1	15.0	566.7	6.5
2	20.0	566.2	6.3
3	25.0	565.8	6.2
4	30.0	565.7	6.4
5	35.0	566.2	7.1
6	40.0	566.3	7.5
7	45.0	566.4	7.9
8	50.0	566.6	8.4
9	55.0	566.8	8.9
10	60.0	567.0	9.4
11	65.0	567.2	9.8
12	70.0	567.4	10.3
13	75.0	567.6	10.8
14	80.0	567.9	11.4
15	85.0	568.2	12.0
16	90.0	568.8	12.9
17	95.0	568.0	12.3
18	100.0	567.8	12.4
19	105.0	567.7	12.6
20	110.0	567.9	13.1
21	115.0	568.4	13.9
22	120.0	568.2	13.9
23	125.0	567.6	13.6
24	130.0	567.0	13.3
Rev Shot	0.0	563.8	15.1

CLEAR CREEK SEISMIC STUDY,

ALTERNATE DAM SITE STUDY
SEISMIC LINE CHRSL-3
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCSL3-2.SPR
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward CCSL3-2.TXE	Reverse CCSL3-5.TXE
Shot Pos:	-15.0	135.0

Time-Distance Line Fit Summary for CCSL3-2.SPR

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1163	586	0.0	15	0.0
Forward	2	10072	935	11.4	1	15.0
Reverse	1	989	458	0.0	15	0.0
Reverse	2	21354	>E3	19.3	1	20.0

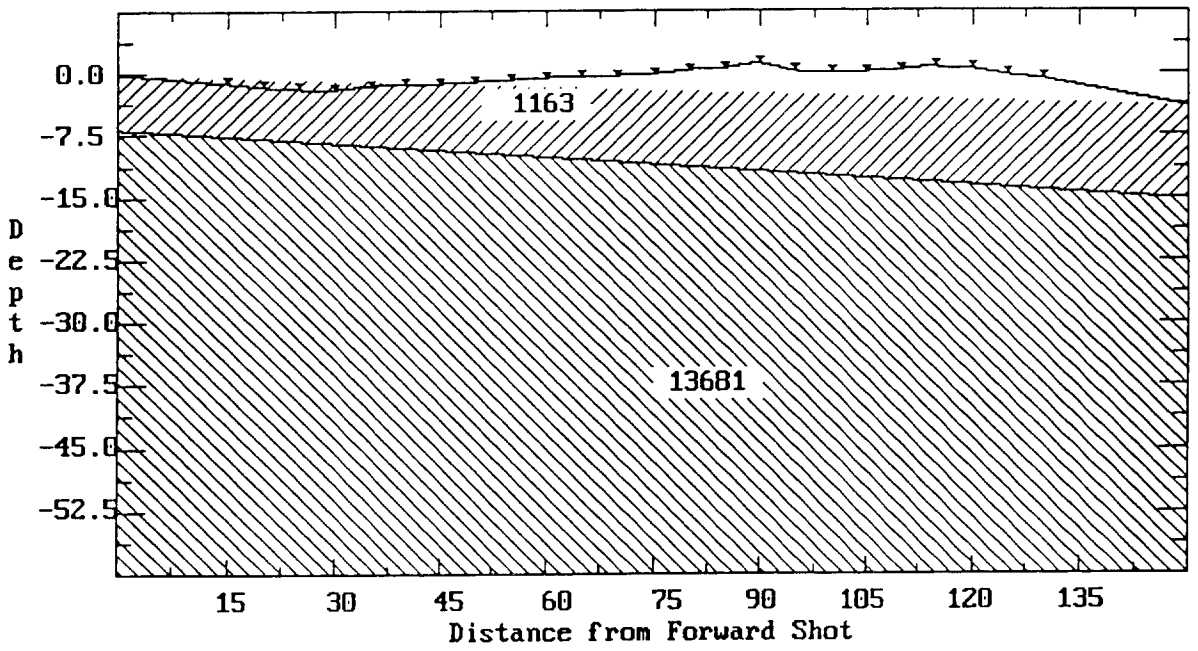
CLEAR CREEK SEISMIC STUDY,

ALTERNATE DAM SITE STUDY
SEISMIC LINE CHRSL-3
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCSL3-2.SPR
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL3-2.TXE	CCSL3-5.TXE
Shot Pos:	-15.0	135.0

Depth Profile Plot for CCSL3-2.SPR



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL3-5.TXE

First Arrival and Elevation Data from CCSL3-5.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	563.80	135.00	
1	566.70	5.00	28.40
2	566.20	10.00	27.70
3	565.80	(15.00)	27.00
4	565.70	(20.00)	26.60
5	566.20	(25.00)	26.00
6	566.30	(30.00)	26.20
7	566.40	(35.00)	26.20
8	566.60	(40.00)	26.10
9	566.80	(45.00)	26.00
10	567.00	(50.00)	25.70
11	567.20	(55.00)	25.30
12	567.40	(60.00)	24.90
13	567.60	(65.00)	25.10
14	567.90	(70.00)	24.70
15	568.20	(75.00)	24.50
16	568.80	(80.00)	24.70
17	568.00	(85.00)	24.80
18	567.80	(90.00)	25.80
19	567.70	(95.00)	24.30
20	567.90	(100.00)	23.00
21	568.40	(105.00)	22.50
22	568.20	(110.00)	21.70
23	567.60	(115.00)	20.90
24	567.00	(120.00)	20.10

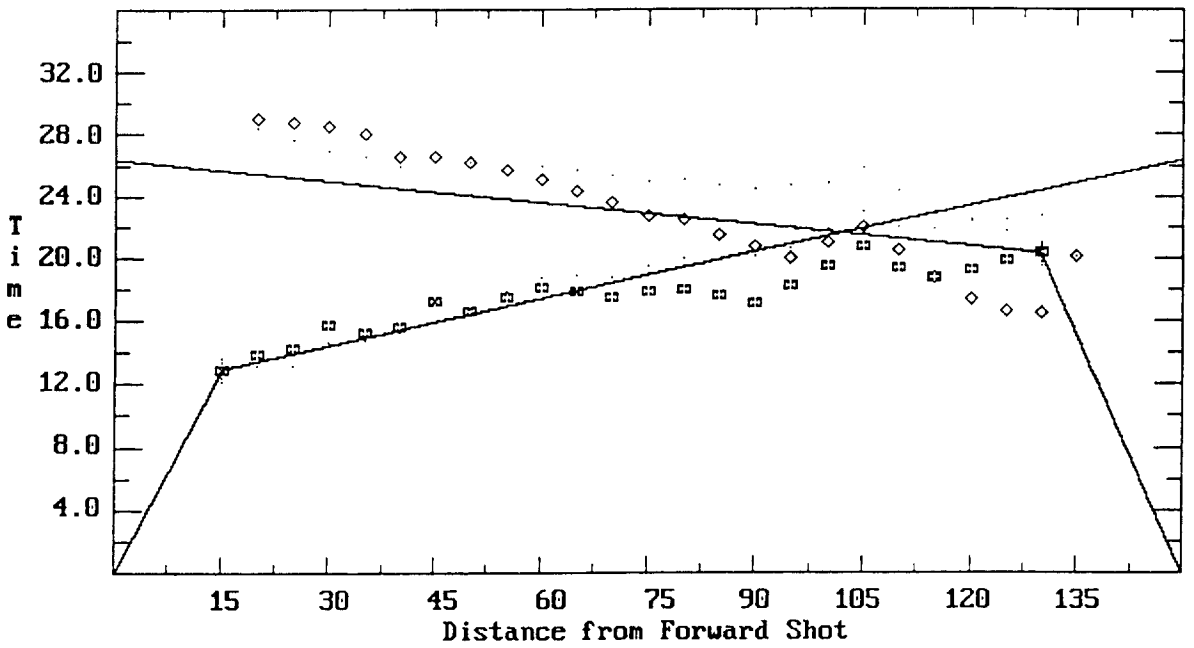
CLEAR CREEK SEISMIC STUDY,

ALTERNATE DAM SITE STUDY
SEISMIC LINE CHRSL-3
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCSL3-2.SPR
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL3-2.TXE	CCSL3-5.TXE
Shot Pos:	-15.0	135.0

Time-Distance Plot for CCSL3-2.SPR



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL3-5.TXE

Header data from file CCSL3005.

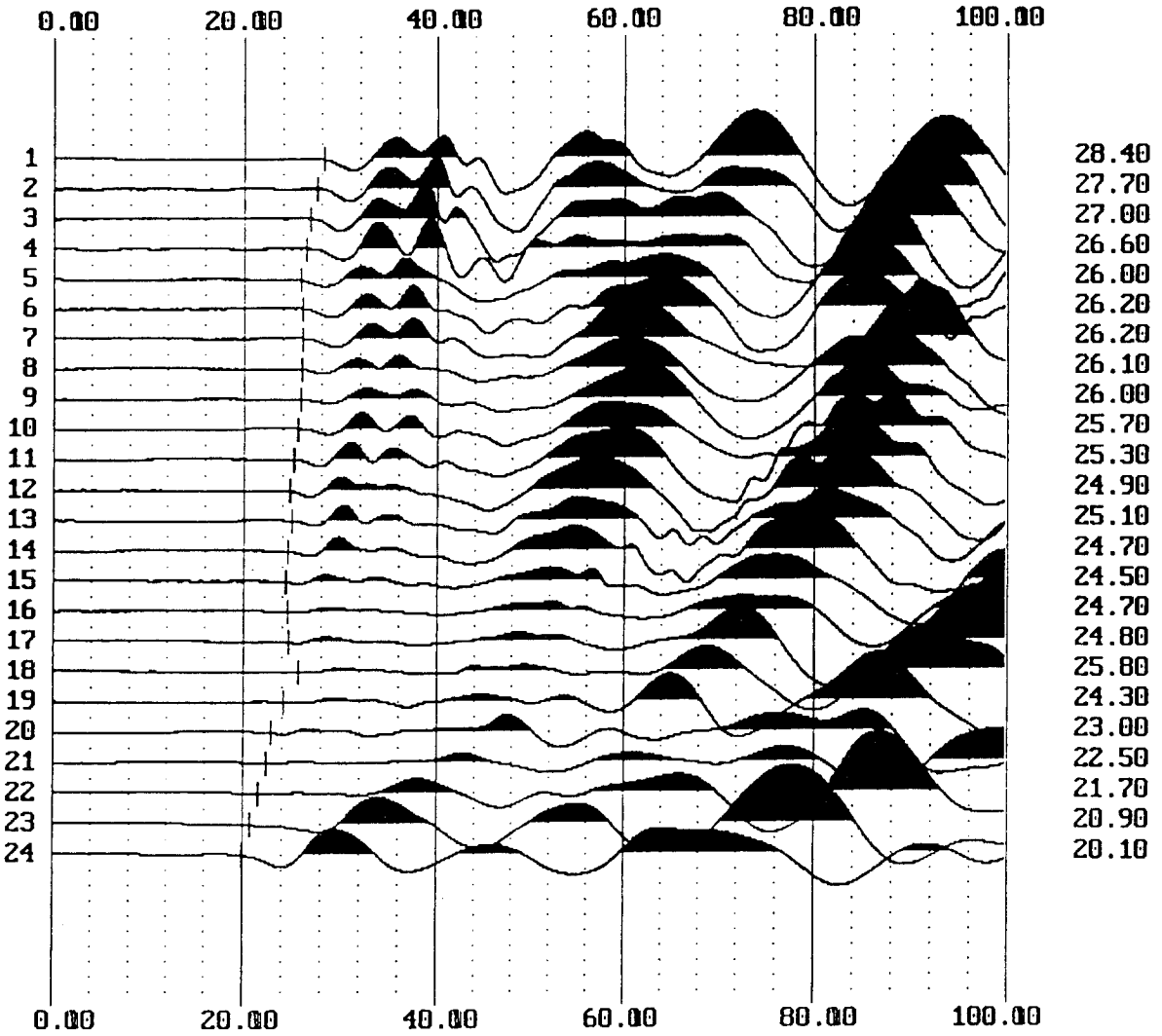
File number:	CCSL3005
Job number:	CLEAR CREEK SEISMIC
Date and time:	0903971106
Operator note:	SHOT POINT 135', PHONE SPACING 5',LINE IN SAND
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	135.0
Shot location Y:	0.0
Shot location Z:	563.8

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL3-5.TXE

Seismic waveform data from file CCSL3005.



Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 4

Phone Spacing: 6' Bearing: N 5 W

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	565.5	1320.0	11162.0	16.04	549.5
1	0	564.7	1320.0	11162.0	14.59	550.1
2	6	564.3	1320.0	11162.0	13.93	550.4
3	12	564.0	1320.0	11162.0	13.37	550.6
4	18	563.5	1320.0	11162.0	12.61	550.9
5	24	563.0	1320.0	11162.0	11.85	551.2
6	30	562.5	1320.0	11162.0	11.09	551.4
7	36	562.0	1320.0	11162.0	10.33	551.7
8	42	561.8	1320.0	11162.0	9.87	551.9
9	48	561.5	1320.0	11162.0	9.31	552.2
10	54	561.7	1320.0	11162.0	9.25	552.5
11	60	562.1	1320.0	11162.0	9.39	552.7
12	66	562.5	1320.0	11162.0	9.83	552.7
13	72	563.9	1320.0	11162.0	10.67	553.2
14	78	563.2	1320.0	11162.0	9.71	553.5
15	84	563.5	1320.0	11162.0	9.75	553.8
16	90	563.5	1320.0	11162.0	9.49	554.0
17	96	562.9	1320.0	11162.0	8.63	554.3
18	102	562.3	1320.0	11162.0	7.77	554.5
19	108	562.0	1320.0	11162.0	7.21	554.8
20	114	561.6	1320.0	11162.0	6.55	555.1
21	120	561.2	1320.0	11162.0	5.89	555.3
22	126	560.8	1320.0	11162.0	5.23	555.6
23	132	560.4	1320.0	11162.0	4.57	555.8
24	138	560.2	1320.0	11162.0	4.11	556.1
SP+15	153	561.5	1320.0	11162.0	4.76	556.7

** error factor +- 3 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL4002.TXE

Header data from file CCSL4002.

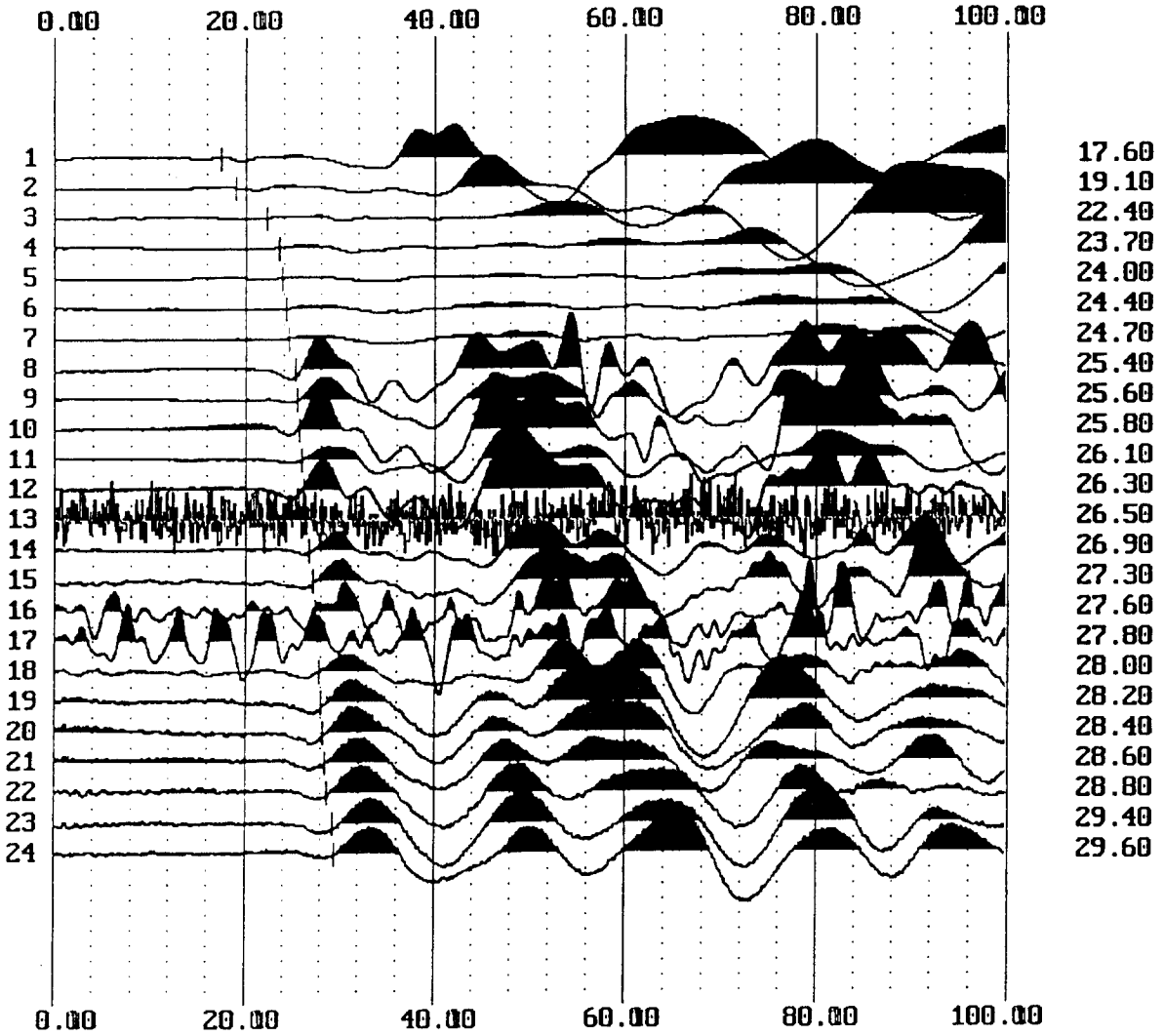
File number:	CCSL4002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0903971259
Operator note:	SHOT POINT -15', PHONE SPACE 6' GRAVELS & COBBLES
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	565.5

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL4002.TXE

Seismic waveform data from file CCSL4002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL4002.TXE

First Arrival and Elevation Data from CCSL4002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	565.50	-15.00	
1	564.70	0.00	17.60
2	564.30	6.00	19.10
3	564.00	12.00	22.40
4	563.50	(18.00)	23.70
5	563.00	(24.00)	24.00
6	562.50	(30.00)	24.40
7	562.00	(36.00)	24.70
8	561.80	(42.00)	25.40
9	561.50	(48.00)	25.60
10	561.70	(54.00)	25.80
11	562.10	(60.00)	26.10
12	562.80	(66.00)	26.30
13	563.90	(72.00)	26.50
14	563.20	(78.00)	26.90
15	563.50	(84.00)	27.30
16	563.50	(90.00)	27.60
17	562.90	(96.00)	27.80
18	562.30	(102.00)	28.00
19	562.00	(108.00)	28.20
20	561.60	(114.00)	28.40
21	561.20	(120.00)	28.60
22	560.80	(126.00)	28.80
23	560.40	(132.00)	29.40
24	560.20	(138.00)	29.60

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL4005.TXE

Header data from file CCSL4005.

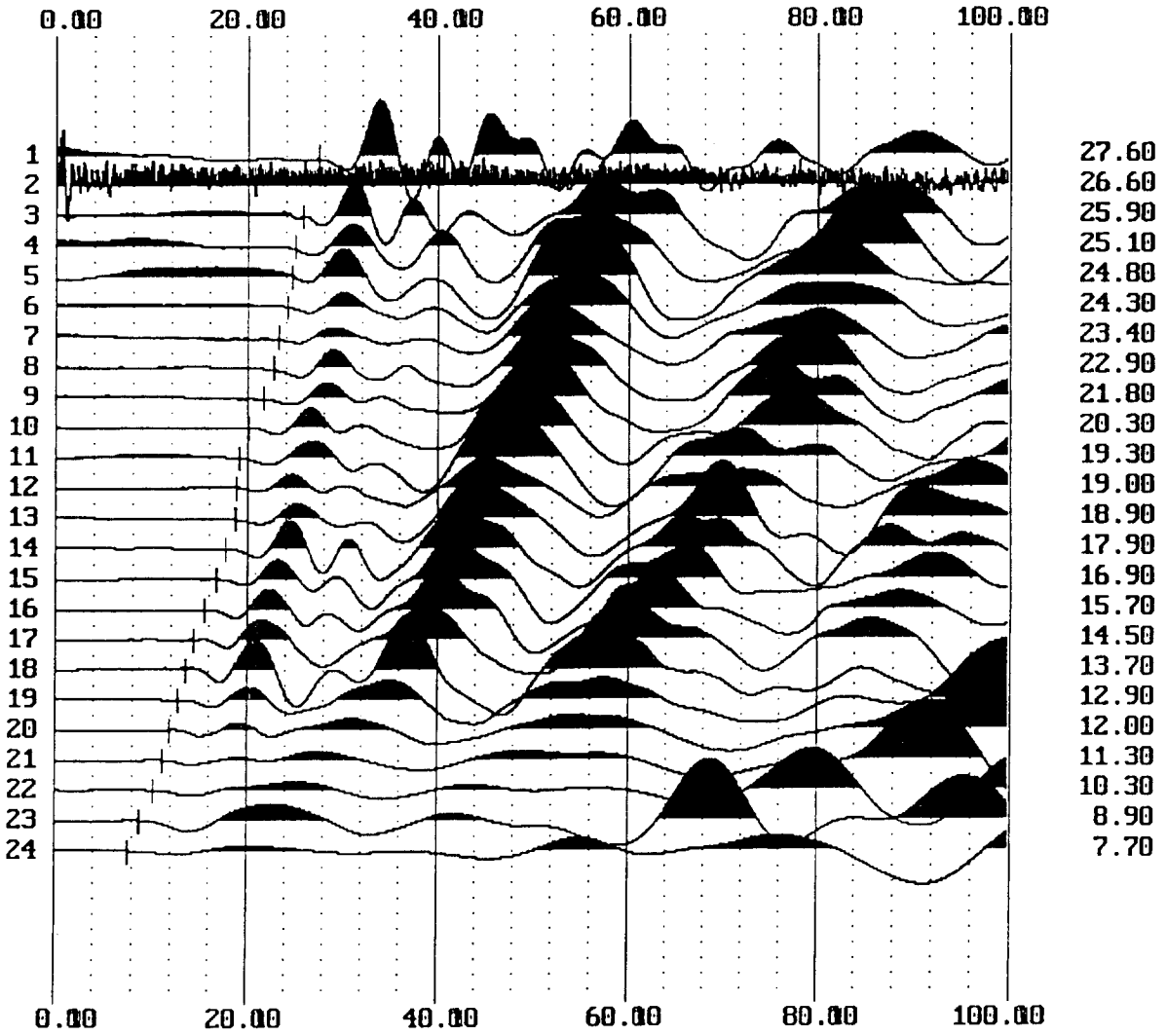
File number:	CCSL4005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0903971315
Operator note:	SHOT POINT 153', PHONE SPACE 6'
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	153.0
Shot location Y:	0.0
Shot location Z:	561.5

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL4005.TXE

Seismic waveform data from file CCSL4005.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL4005.TXE

First Arrival and Elevation Data from CCSL4005.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	561.50	153.00	
1	564.70	0.00	27.60
2	564.30	6.00	26.60
3	564.00	12.00	25.90
4	563.50	(18.00)	25.10
5	563.00	(24.00)	24.80
6	562.50	(30.00)	24.30
7	562.00	(36.00)	23.40
8	561.80	(42.00)	22.90
9	561.50	(48.00)	21.80
10	561.70	(54.00)	20.30
11	562.10	(60.00)	19.30
12	562.80	(66.00)	19.00
13	563.90	(72.00)	18.90
14	563.20	(78.00)	17.90
15	563.50	(84.00)	16.90
16	563.50	(90.00)	15.70
17	562.90	(96.00)	14.50
18	562.30	(102.00)	13.70
19	562.00	(108.00)	12.90
20	561.60	(114.00)	12.00
21	561.20	(120.00)	11.30
22	560.80	(126.00)	10.30
23	560.43	(132.00)	8.90
24	560.20	(138.00)	7.70

CLEAR CREEK SEISMIC SURVEY

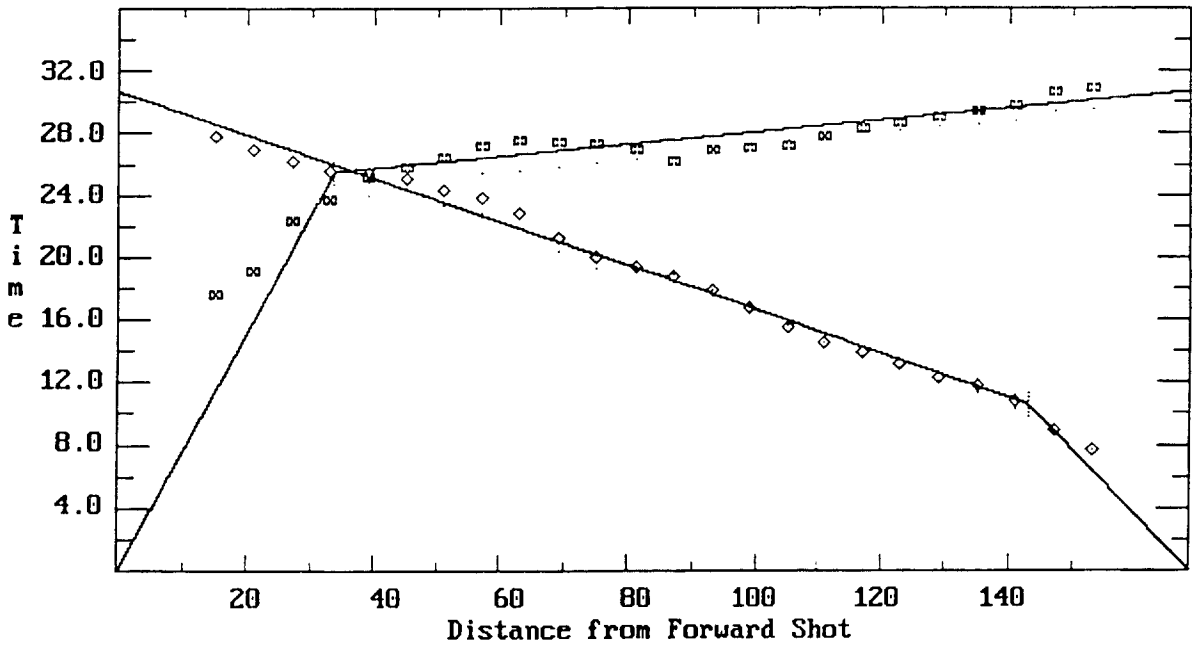
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL4002.TXE	CCSL4005.TXE
Shot Pos:	-15.0	153.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL4002.TXE	CCSL4005.TXE
Shot Pos:	-15.0	153.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1320	270	0.0	4	0.0
Forward	2	25735	>E3	24.1	0	33.5
Reverse	1	2343	735	0.0	4	0.0
Reverse	2	7147	129	7.1	0	24.8

CLEAR CREEK SEISMIC SURVEY

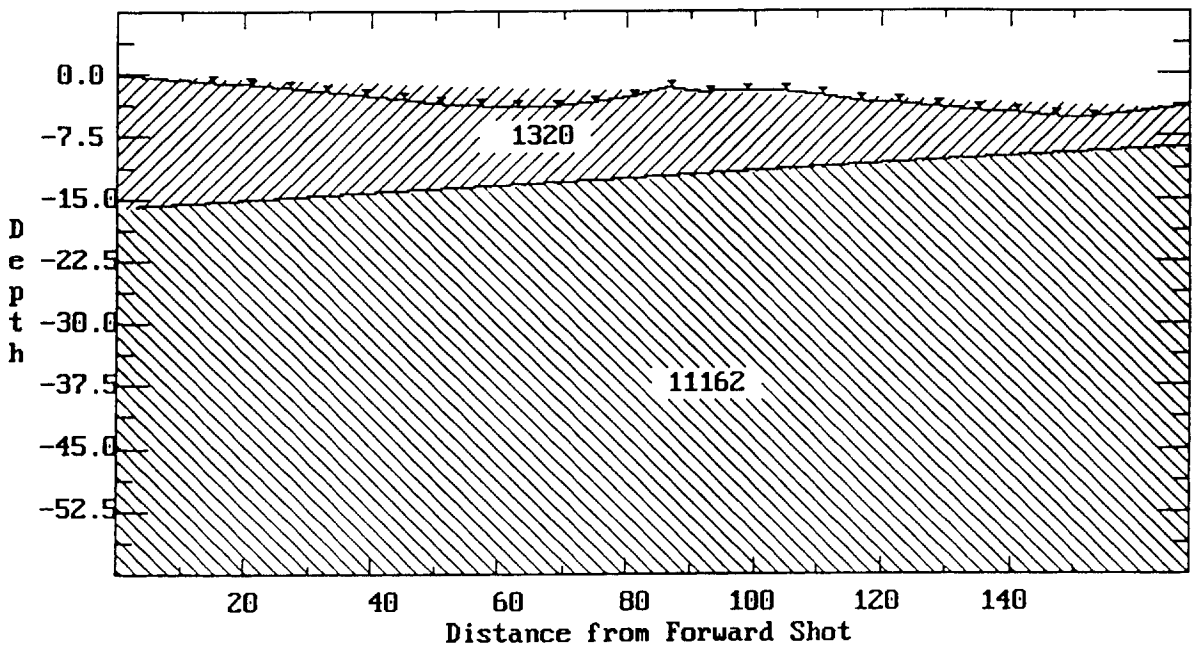
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL4002.TXE	CCSL4005.TXE
Shot Pos:	-15.0	153.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

		Layer 1	Layer 2
	Velocity:	1320	11162
	Dip Angle:	-1.36	1.12
	Averaging Interval:	3- 168	
Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	565.5	16.0
1	15.0	564.7	14.6
2	21.0	564.3	13.9
3	27.0	564.0	13.4
4	33.0	563.5	12.6
5	39.0	563.0	11.9
6	45.0	562.5	11.1
7	51.0	562.0	10.3
8	57.0	561.8	9.9
9	63.0	561.5	9.3
10	69.0	561.7	9.3
11	75.0	562.1	9.4
12	81.0	562.8	9.8
13	87.0	563.9	10.7
14	93.0	563.2	9.7
15	99.0	563.5	9.7
16	105.0	563.5	9.5
17	111.0	562.9	8.6
18	117.0	562.3	7.8
19	123.0	562.0	7.2
20	129.0	561.6	6.5
21	135.0	561.2	5.9
22	141.0	560.8	5.2
23	147.0	560.4	4.6
24	153.0	560.2	4.1
Rev Shot	0.0	561.5	8.8

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 5

Phone Spacing: 8' Bearing: N 35 E

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	565.6	735.0	14544.0	7.22	558.4
1	0	566.5	735.0	14544.0	7.90	558.6
2	8	566.8	735.0	14544.0	8.55	558.3
3	16	566.5	735.0	14544.0	8.30	558.2
4	24	566.2	735.0	14544.0	8.04	558.2
5	32	566.0	735.0	14544.0	7.89	558.1
6	40	565.7	735.0	14544.0	7.63	558.1
7	48	566.2	735.0	14544.0	8.18	558.0
8	56	566.0	735.0	14544.0	8.02	558.0
9	64	566.2	735.0	14544.0	8.27	557.9
10	72	566.5	735.0	14544.0	8.61	557.9
11	80	566.7	735.0	14544.0	8.86	557.8
12	88	566.9	735.0	14544.0	9.11	557.8
13	96	567.1	735.0	14544.0	9.35	557.8
14	104	567.3	735.0	14544.0	9.60	557.7
15	112	567.6	735.0	14544.0	9.94	557.7
16	120	567.8	735.0	14544.0	10.19	557.6
17	128	567.6	735.0	14544.0	10.03	557.6
18	136	567.4	735.0	14544.0	9.88	557.5
19	144	567.2	735.0	14544.0	9.72	557.5
20	152	567.0	735.0	14544.0	9.57	557.4
21	160	566.7	735.0	14544.0	9.32	557.4
22	168	566.5	735.0	14544.0	9.16	557.3
23	176	566.3	735.0	14544.0	9.01	557.3
24	184	566.1	735.0	14544.0	8.85	557.3
SP+15	199	565.4	735.0	14544.0	8.24	557.2

** error factor +-4 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File: CCSL5002.TXE

Header data from file CCSL5002.

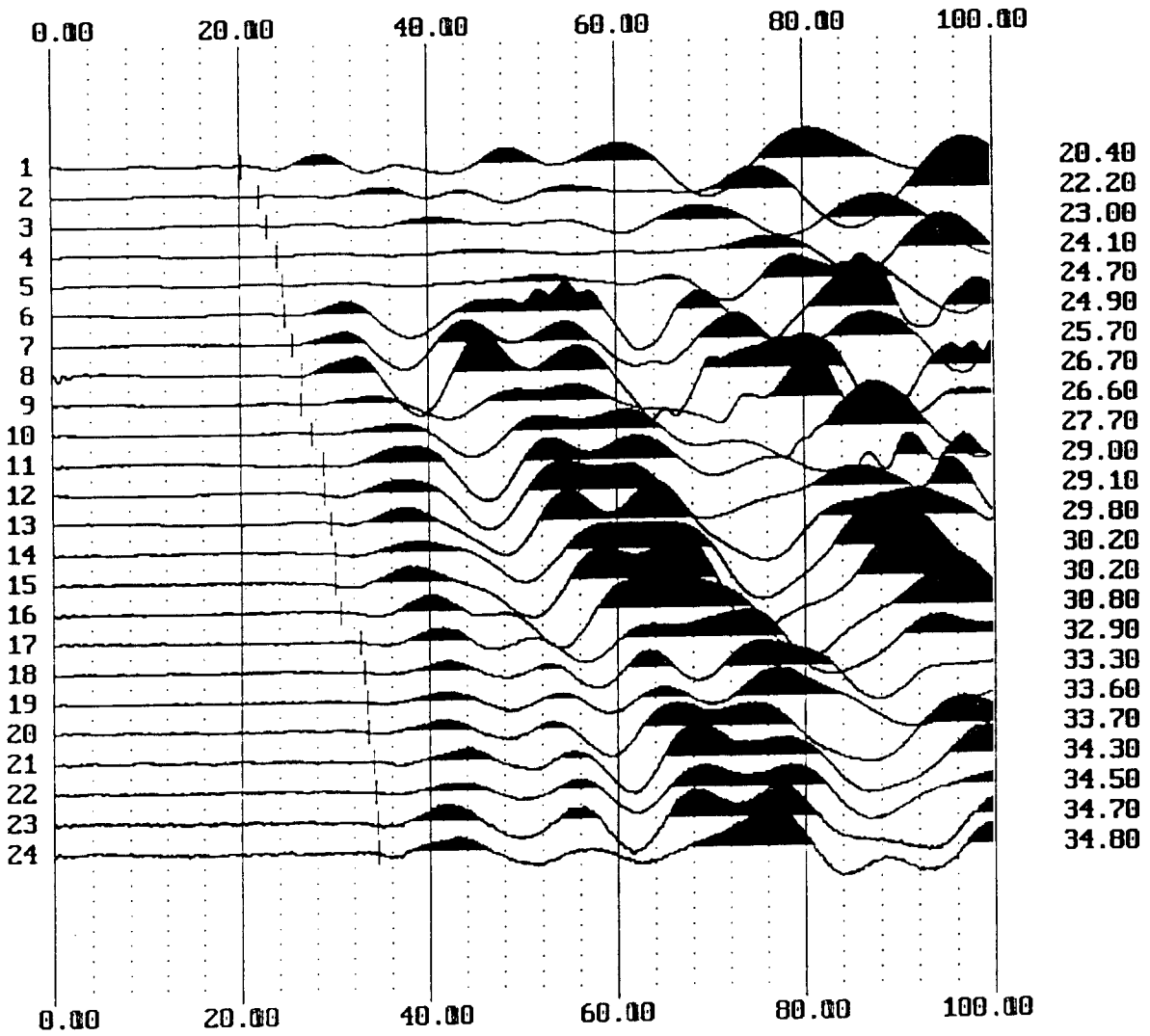
File number:	CCSL5002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0903971503
Operator note:	SHOT POINT -15', PHONE SPACE 8' SANDY SOIL
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	565.6

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL5002.TXE

Seismic waveform data from file CCSL5002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL5002.TXE

First Arrival and Elevation Data from CCSL5002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	565.60	-15.00	
1	566.20	0.00	20.40
2	566.80	8.00	22.20
3	566.50	16.00	23.00
4	566.20	(24.00)	24.10
5	566.00	(32.00)	24.70
6	565.70	(40.00)	24.90
7	566.20	(48.00)	25.70
8	566.00	(56.00)	26.70
9	566.20	(64.00)	26.60
10	566.50	(72.00)	27.70
11	566.70	(80.00)	29.00
12	566.90	(88.00)	29.10
13	567.10	(96.00)	29.80
14	567.30	(104.00)	30.20
15	567.60	(112.00)	30.20
16	567.80	(120.00)	30.80
17	567.60	(128.00)	32.90
18	567.40	(136.00)	33.30
19	567.20	(144.00)	33.60
20	567.00	(152.00)	33.70
21	566.70	(160.00)	34.30
22	566.50	(168.00)	34.50
23	566.30	(176.00)	34.70
24	566.10	(184.00)	34.80

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL5005.TXE

Header data from file CCSL5005.

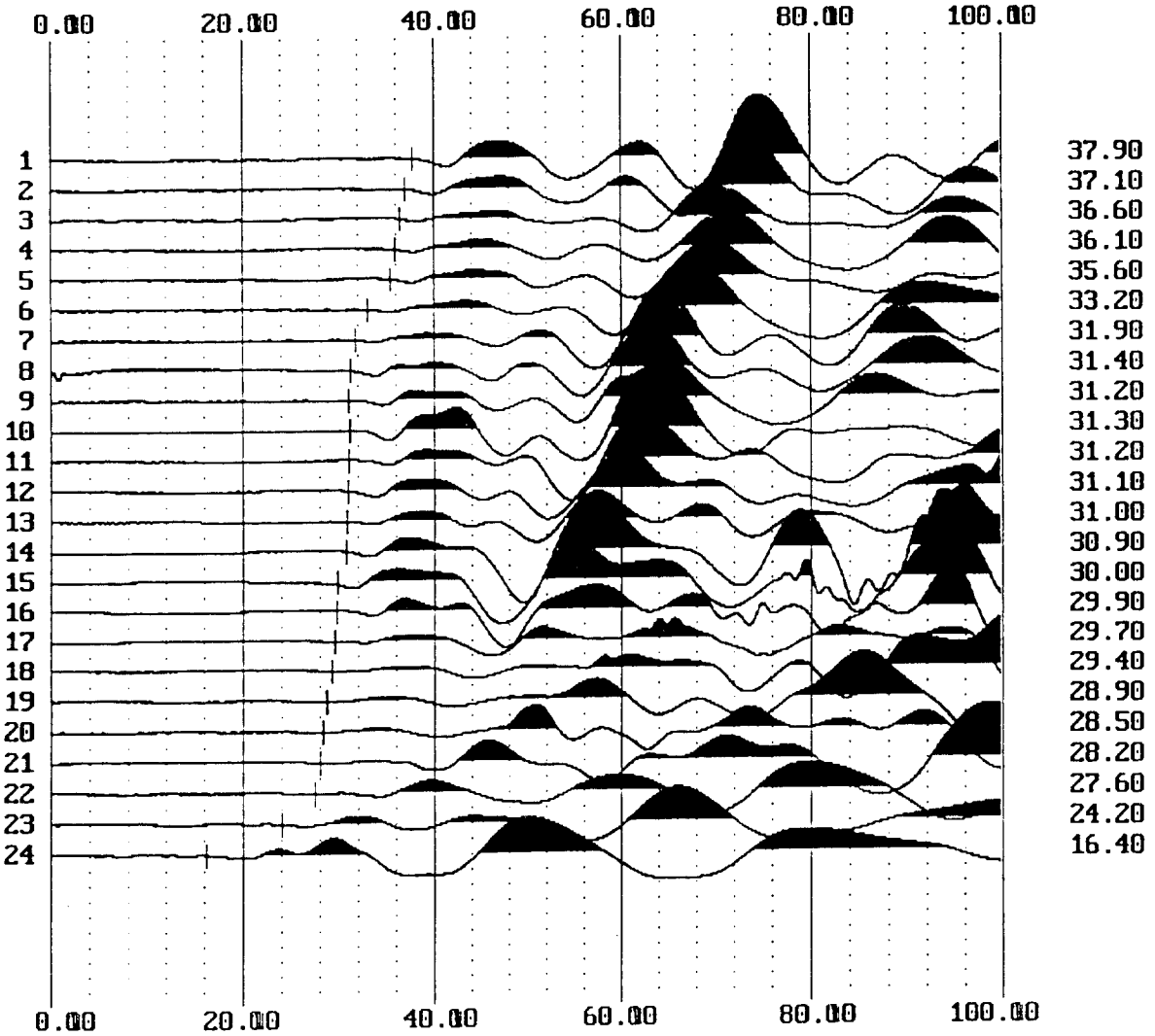
File number:	CCSL5005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0903971512
Operator note:	SHOT POINT 199′, PHONE SPACE 8′, SANDY SOIL
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	199.0
Shot location Y:	0.0
Shot location Z:	565.4

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL5005.TXE

Seismic waveform data from file CCSL5005.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL5005.TXE

First Arrival and Elevation Data from CCSL5005.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	565.40	(199.00)	
1	566.50	0.00	37.90
2	566.80	8.00	37.10
3	566.50	16.00	36.60
4	566.20	(24.00)	36.10
5	566.00	(32.00)	35.60
6	565.70	(40.00)	33.20
7	566.20	(48.00)	31.90
8	566.00	(56.00)	31.40
9	566.20	(64.00)	31.20
10	566.50	(72.00)	31.30
11	566.70	(80.00)	31.20
12	566.90	(88.00)	31.10
13	567.10	(96.00)	31.00
14	567.30	(104.00)	30.90
15	567.60	(112.00)	30.00
16	567.80	(120.00)	29.90
17	567.60	(128.00)	29.70
18	567.40	(136.00)	29.40
19	567.20	(144.00)	28.90
20	567.00	(152.00)	28.50
21	566.70	(160.00)	28.20
22	566.50	(168.00)	27.60
23	566.30	(176.00)	24.20
24	566.10	(184.00)	16.40

CLEAR CREEK SEISMIC SURVEY

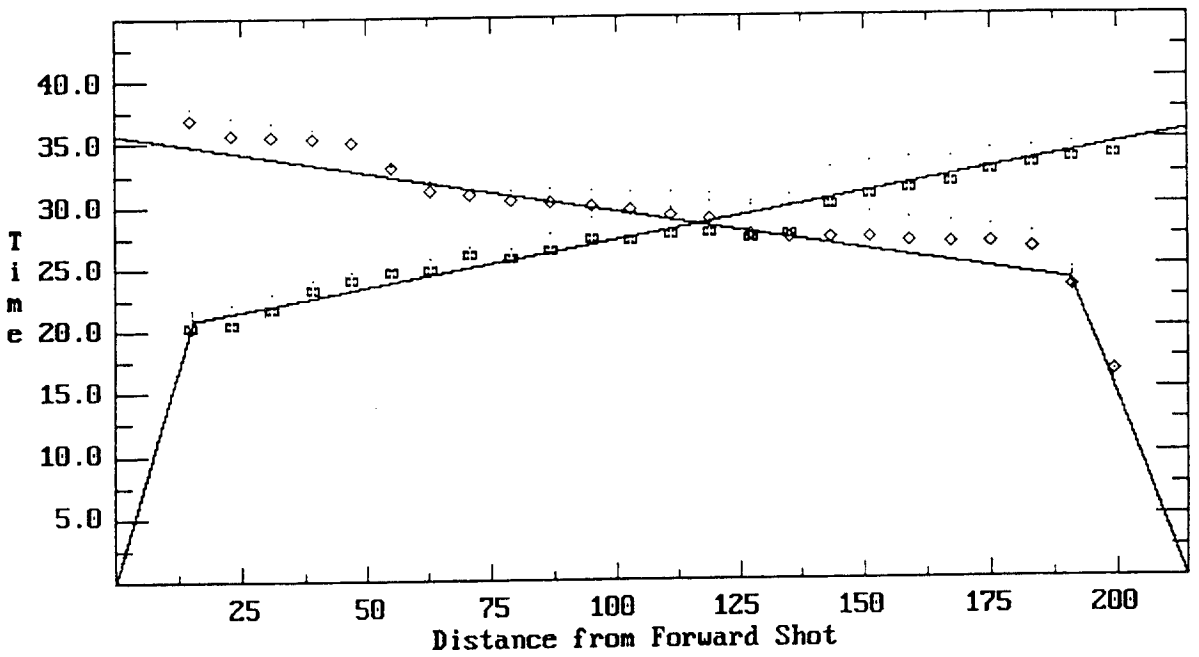
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL5002.TXE	CCSL5005.TXE
Shot Pos:	-15.0	199.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL5002.TXE	CCSL5005.TXE
Shot Pos:	-15.0	199.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	735	0	0.0	0	0.0
Forward	2	13295	497	19.6	0	15.3
Reverse	1	966	0	0.0	0	0.0
Reverse	2	16054	719	22.4	0	23.0

CLEAR CREEK SEISMIC SURVEY

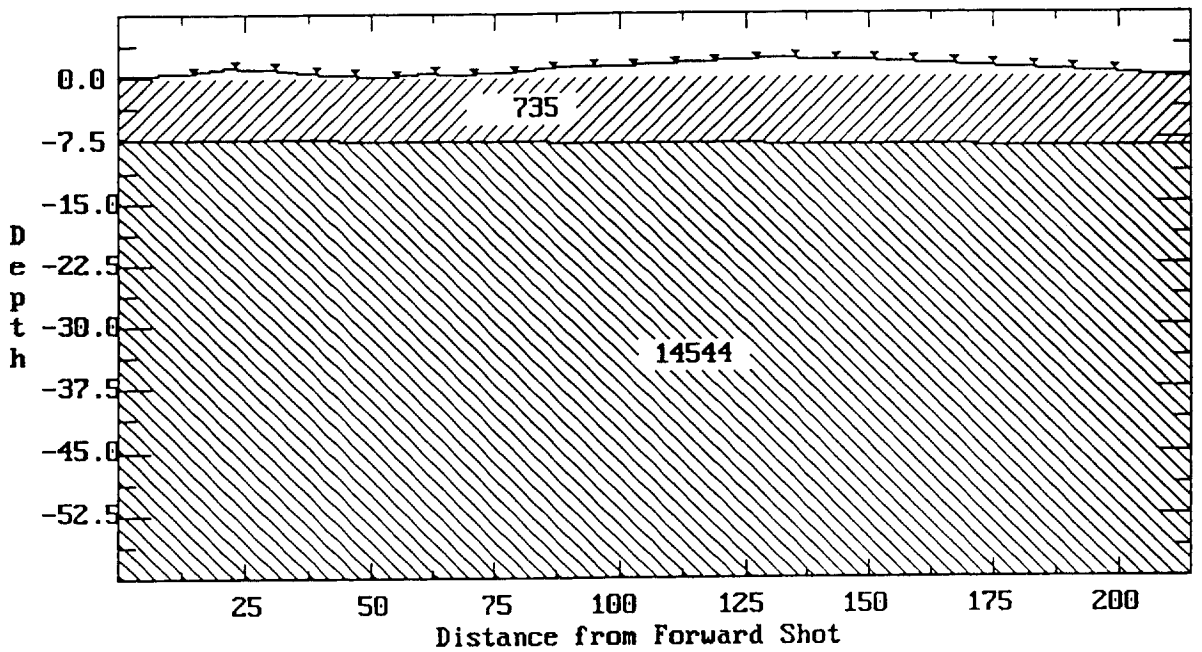
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL5002.TXE	CCSL5005.TXE
Shot Pos:	-15.0	199.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	735	14544
Dip Angle:	-0.05	-0.38
Averaging Interval:	0- 214	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	565.6	7.2
1	15.0	566.2	7.9
2	23.0	566.8	8.6
3	31.0	566.5	8.3
4	39.0	566.2	8.0
5	47.0	566.0	7.9
6	55.0	565.7	7.6
7	63.0	566.2	8.2
8	71.0	566.0	8.0
9	79.0	566.2	8.3
10	87.0	566.5	8.6
11	95.0	566.7	8.9
12	103.0	566.9	9.1
13	111.0	567.1	9.4
14	119.0	567.3	9.6
15	127.0	567.6	9.9
16	135.0	567.8	10.2
17	143.0	567.6	10.0
18	151.0	567.4	9.9
19	159.0	567.2	9.7
20	167.0	567.0	9.6
21	175.0	566.7	9.3
22	183.0	566.5	9.2
23	191.0	566.3	9.0
24	199.0	566.1	8.9
Rev Shot	0.0	565.4	8.4

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 6

Phone Spacing: 10' Bearing: N 63 E

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	565.0	1107.0	10753.0	12.01	553.0
1	0	565.5	1107.0	10753.0	12.88	552.6
2	10	565.8	1107.0	10753.0	13.43	552.4
3	20	567.0	1107.0	10753.0	14.88	552.1
4	30	567.2	1107.0	10753.0	15.32	551.9
5	40	566.6	1107.0	10753.0	14.97	551.6
6	50	565.8	1107.0	10753.0	14.42	551.4
7	60	565.6	1107.0	10753.0	14.47	551.1
8	70	565.6	1107.0	10753.0	14.71	550.9
9	80	565.6	1107.0	10753.0	14.96	550.6
10	90	565.6	1107.0	10753.0	15.21	550.4
11	100	565.6	1107.0	10753.0	15.45	550.2
12	110	565.6	1107.0	10753.0	15.70	549.9
13	120	565.6	1107.0	10753.0	15.95	549.7
14	130	565.6	1107.0	10753.0	16.19	549.4
15	140	565.6	1107.0	10753.0	16.44	549.2
16	150	565.6	1107.0	10753.0	16.69	548.9
17	160	565.6	1107.0	10753.0	16.94	548.7
18	170	565.6	1107.0	10753.0	17.18	548.4
19	180	565.6	1107.0	10753.0	17.43	548.2
20	190	565.6	1107.0	10753.0	17.68	547.9
21	200	565.8	1107.0	10753.0	18.12	547.7
22	210	565.9	1107.0	10753.0	18.37	547.5
23	220	565.8	1107.0	10753.0	18.62	547.2
24	230	565.5	1107.0	10753.0	18.57	546.9
SP+15	245	564.2	1107.0	10753.0	17.64	546.6

** error factor +-5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL6002.TXE

Header data from file CCSL6002.

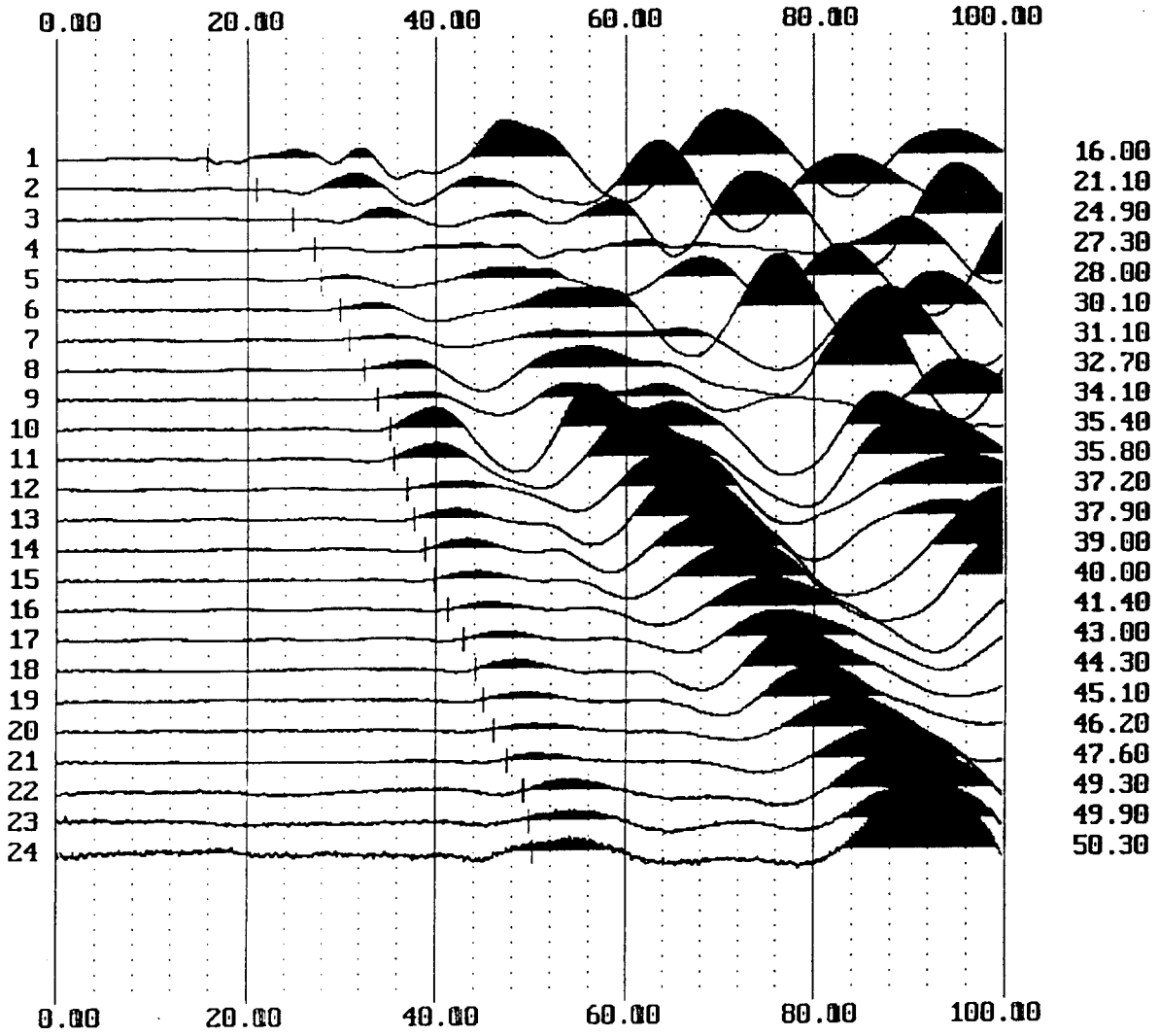
File number:	CCSL6002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904970833
Operator note:	SHOT POINT-15', PHONE SPACE 10', LINE IN ROAD
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	565.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL6002.TXE

Seismic waveform data from file CCSL6002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL6002.TXE

First Arrival and Elevation Data from CCSL6002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	565.00	-15.00	
1	565.50	0.00	16.00
2	565.80	10.00	21.10
3	567.00	20.00	24.90
4	567.20	(30.00)	27.30
5	566.60	(40.00)	28.00
6	565.80	(50.00)	30.10
7	565.60	(60.00)	31.10
8	565.60	(70.00)	32.70
9	565.60	(80.00)	34.10
10	565.60	(90.00)	35.40
11	565.60	(100.00)	35.80
12	565.60	(110.00)	37.20
13	565.60	(120.00)	37.90
14	565.60	(130.00)	39.00
15	565.60	(140.00)	40.00
16	565.60	(150.00)	41.40
17	565.60	(160.00)	43.00
18	565.60	(170.00)	44.30
19	565.60	(180.00)	45.10
20	565.60	(190.00)	46.20
21	565.80	(200.00)	47.60
22	565.80	(210.00)	49.30
23	565.80	(220.00)	49.90
24	565.50	(230.00)	50.30

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL6005.TXE

Header data from file CCSL6005.

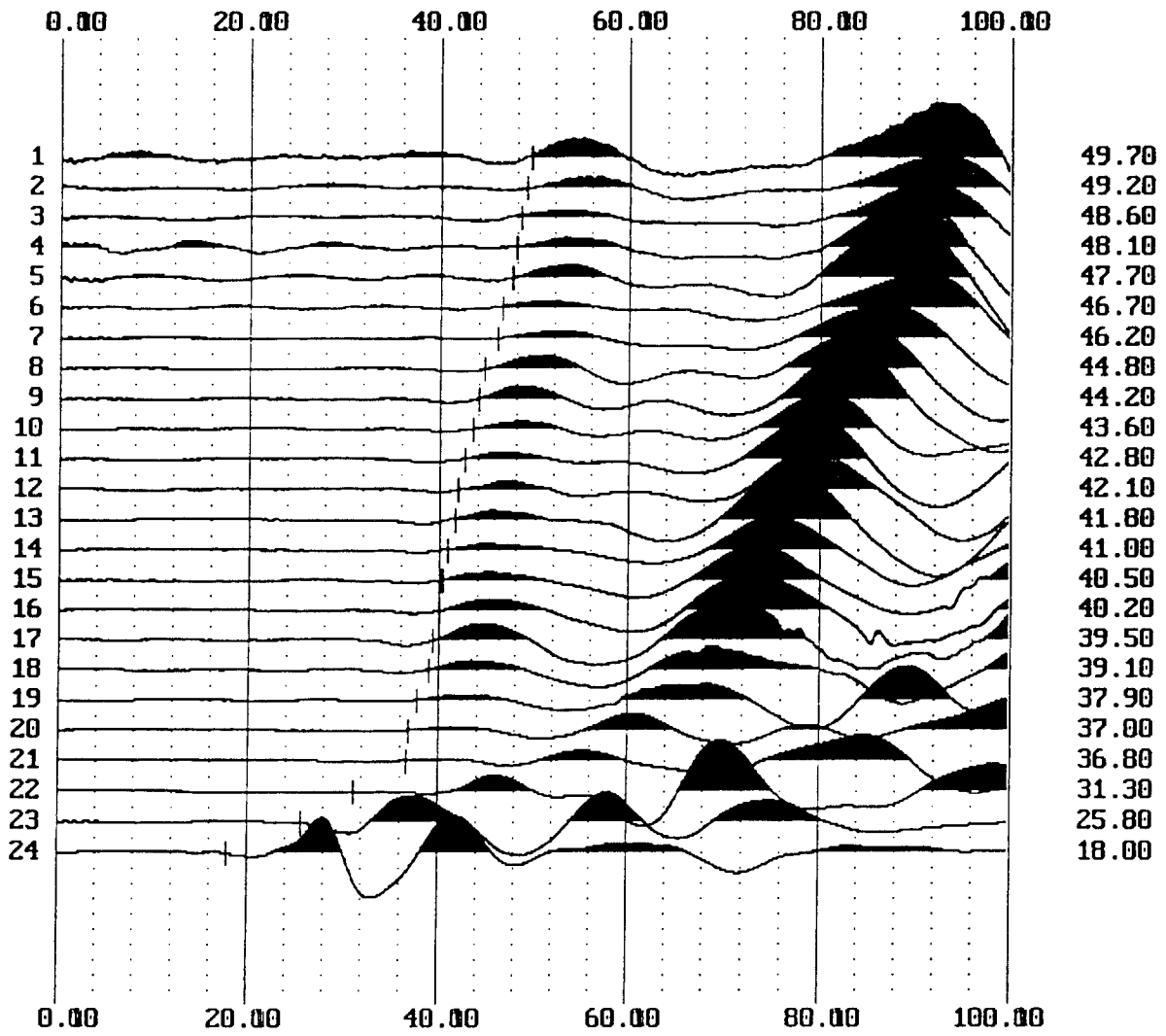
File number:	CCSL6005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904970838
Operator note:	SHOT POINT 245', PHONE SPACE 10', LINE IN ROAD
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	245.0
Shot location Y:	0.0
Shot location Z:	564.2

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File: CCSL6005.TXL

Seismic waveform data from file CCSL6005.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL6005.TXE

First Arrival and Elevation Data from CCSL6005.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	564.20	245.00	
1	565.50	0.00	49.70
2	565.80	10.00	49.20
3	567.00	20.00	48.60
4	567.20	(30.00)	48.10
5	566.60	(40.00)	47.70
6	565.80	(50.00)	46.70
7	565.60	(60.00)	46.20
8	565.60	(70.00)	44.80
9	565.60	(80.00)	44.20
10	565.60	(90.00)	43.60
11	565.60	(100.00)	42.80
12	565.60	(110.00)	42.10
13	565.60	(120.00)	41.80
14	565.60	(130.00)	41.00
15	565.60	(140.00)	40.50
16	565.60	(150.00)	40.20
17	565.60	(160.00)	39.50
18	565.60	(170.00)	39.10
19	565.60	(180.00)	37.90
20	565.60	(190.00)	37.00
21	565.80	(200.00)	36.80
22	565.90	(210.00)	31.30
23	565.80	(220.00)	25.80
24	565.50	(230.00)	18.00

CLEAR CREEK SEISMIC SURVEY

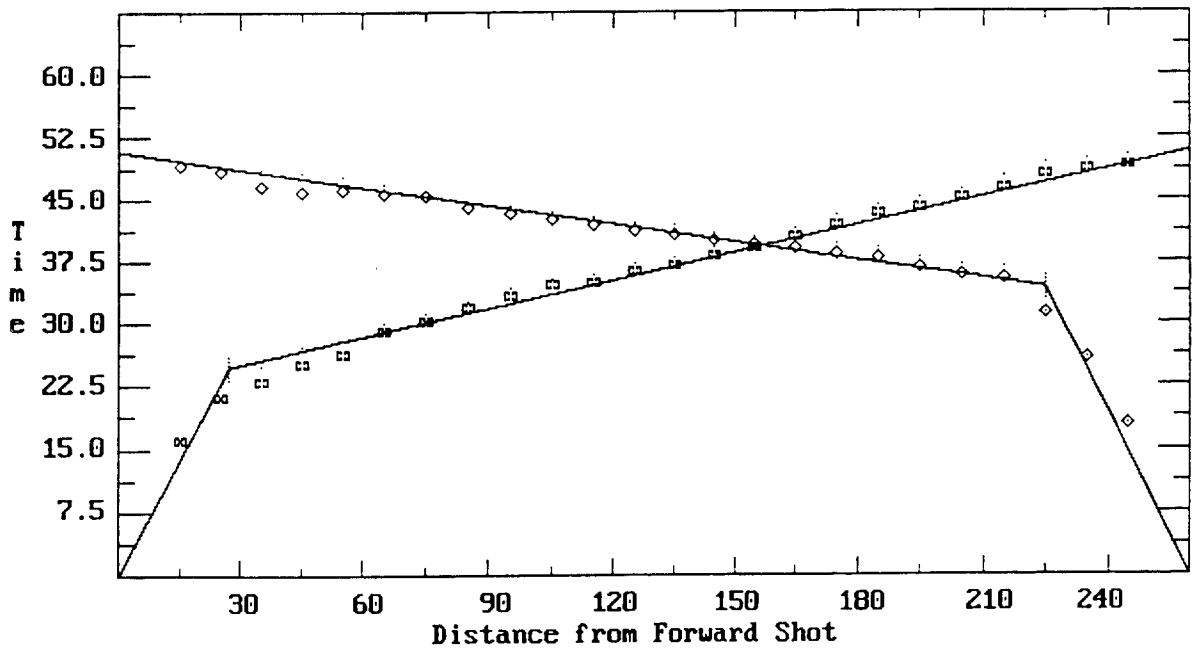
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL6002.TXE	CCSL6005.TXE
Shot Pos:	-15.0	245.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL6002.TXE	CCSL6005.TXE
Shot Pos:	-15.0	245.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1107	153	0.0	4	0.0
Forward	2	8897	152	21.6	0	27.3
Reverse	1	1032	135	0.0	4	0.0
Reverse	2	13598	352	31.7	0	35.4

CLEAR CREEK SEISMIC SURVEY

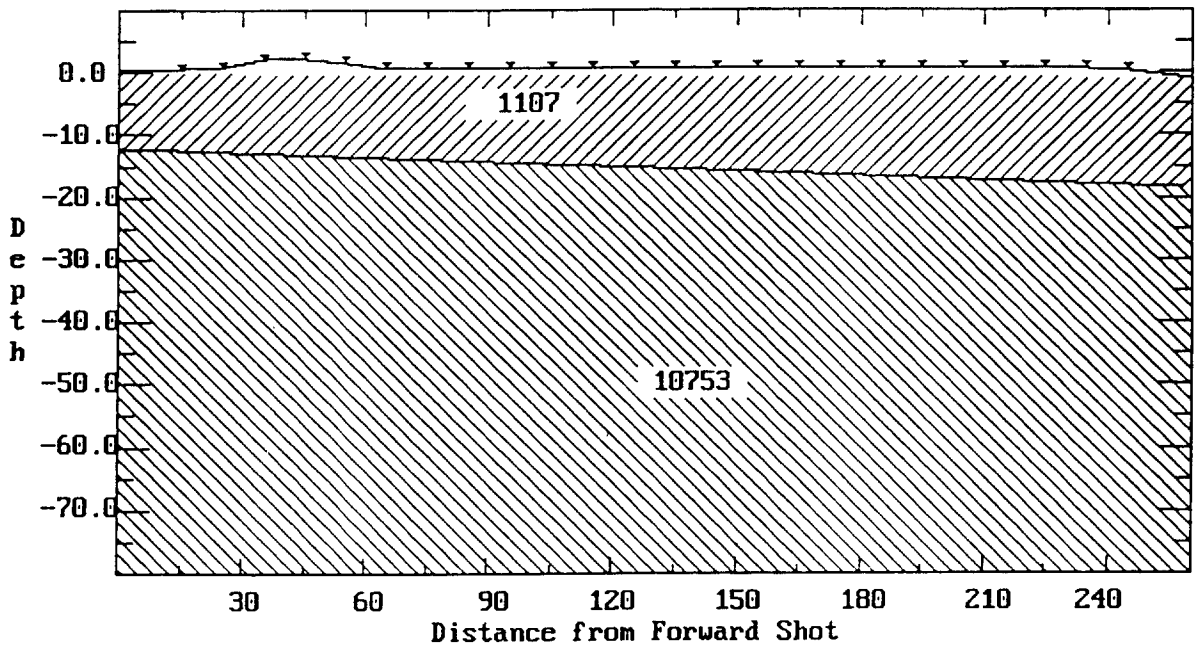
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL6002.TXE	CCSL6005.TXE
Shot Pos:	-15.0	245.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	1107	10753
Dip Angle:	-0.18	-1.59
Averaging Interval:	1- 258	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	565.0	12.0
1	15.0	565.5	12.9
2	25.0	565.8	13.4
3	35.0	567.0	14.9
4	45.0	567.2	15.3
5	55.0	566.6	15.0
6	65.0	565.8	14.4
7	75.0	565.6	14.5
8	85.0	565.6	14.7
9	95.0	565.6	15.0
10	105.0	565.6	15.2
11	115.0	565.6	15.5
12	125.0	565.6	15.7
13	135.0	565.6	15.9
14	145.0	565.6	16.2
15	155.0	565.6	16.4
16	165.0	565.6	16.7
17	175.0	565.6	16.9
18	185.0	565.6	17.2
19	195.0	565.6	17.4
20	205.0	565.6	17.7
21	215.0	565.8	18.1
22	225.0	565.8	18.4
23	235.0	565.8	18.6
24	245.0	565.5	18.6
Rev Shot	0.0	564.2	18.4

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 7

Phone Spacing: 7' Bearing: N 10 E

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	565.5	1430.0	12609.0	8.46	557.0
1	0	565.0	1430.0	12609.0	8.70	556.3
2	7	564.7	1430.0	12609.0	8.75	556.0
3	14	564.3	1430.0	12609.0	8.69	555.6
4	21	564.0	1430.0	12609.0	8.74	555.3
5	28	563.8	1430.0	12609.0	8.80	555.0
6	35	563.6	1430.0	12609.0	9.03	554.6
7	42	563.6	1430.0	12609.0	9.37	554.2
8	49	563.8	1430.0	12609.0	9.91	553.9
9	56	564.0	1430.0	12609.0	10.46	553.5
10	63	564.5	1430.0	12609.0	11.30	553.2
11	70	564.0	1430.0	12609.0	11.15	552.9
12	77	563.7	1430.0	12609.0	11.19	552.5
13	84	564.2	1430.0	12609.0	12.04	552.2
14	91	564.6	1430.0	12609.0	12.78	551.8
15	98	564.9	1430.0	12609.0	13.43	551.5
16	105	565.2	1430.0	12609.0	14.07	551.1
17	112	565.5	1430.0	12609.0	14.72	550.8
18	119	565.2	1430.0	12609.0	14.76	550.4
19	126	564.9	1430.0	12609.0	14.80	550.1
20	133	564.6	1430.0	12609.0	14.85	549.8
21	140	564.3	1430.0	12609.0	14.89	549.4
22	147	564.0	1430.0	12609.0	14.94	549.1
23	154	564.2	1430.0	12609.0	15.48	548.7
24	161	564.3	1430.0	12609.0	15.93	548.4
SP+5	166	564.4	1430.0	12609.0	16.57	547.8

** error factor +- 3.5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File: CCSL7002.TX_

Header data from file CCSL7002.

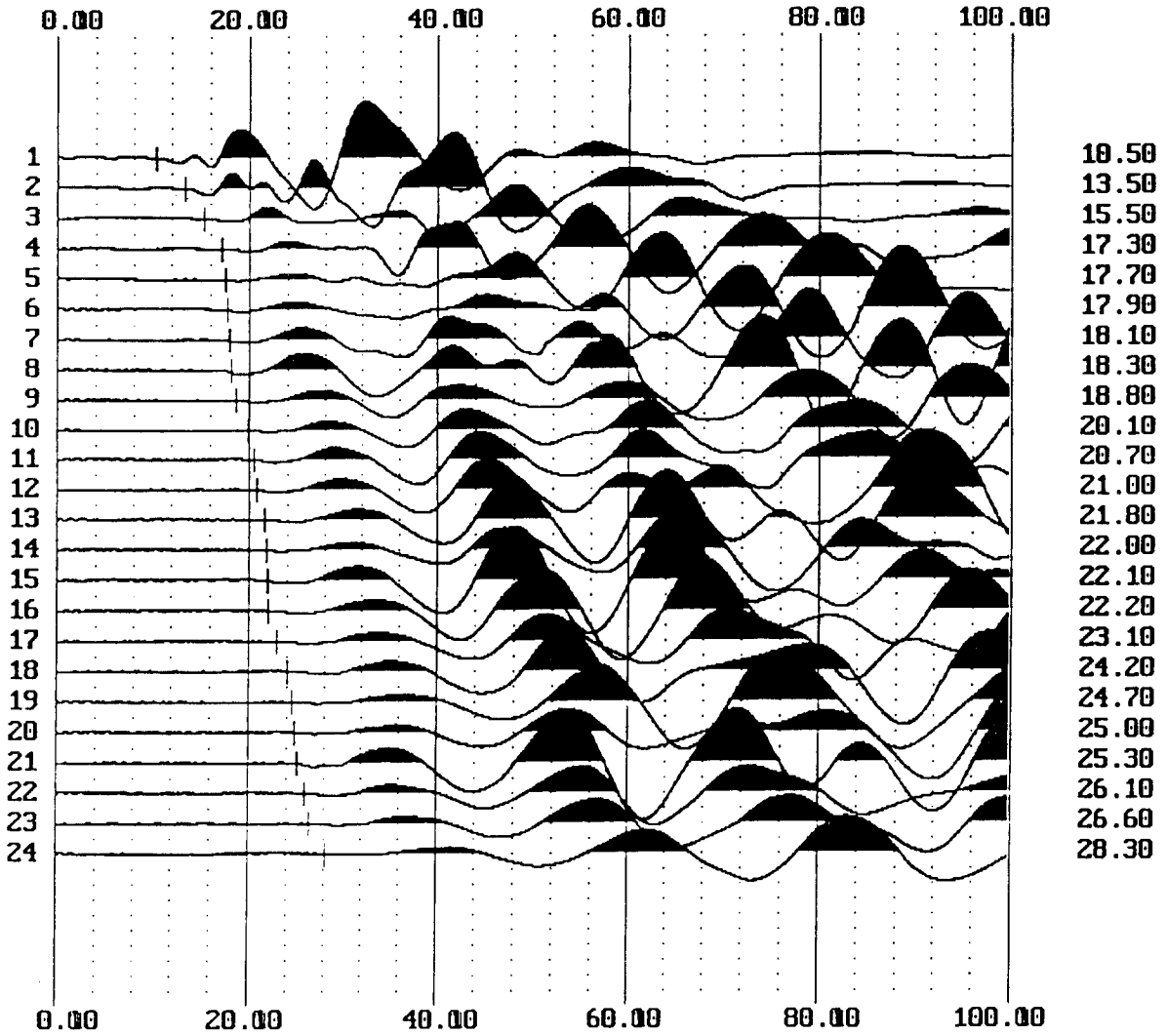
File number:	CCSL7002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904971014
Operator note:	SHOT POINT -15', PHONE SPACE 7', LINE ALONG DRAINAGE
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	565.5

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL7002.TXE

Seismic waveform data from file CCSL7002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL7002.TXE

First Arrival and Elevation Data from CCSL7002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	565.50	-15.00	
1	565.00	0.00	10.50
2	564.70	7.00	13.50
3	564.30	14.00	15.50
4	564.00	(21.00)	17.30
5	563.80	(28.00)	17.70
6	563.60	(35.00)	17.90
7	563.60	(42.00)	18.10
8	563.80	(49.00)	18.30
9	564.00	(56.00)	18.80
10	564.50	(63.00)	20.10
11	564.00	(70.00)	20.70
12	563.70	(77.00)	21.00
13	564.20	(84.00)	21.80
14	564.60	(91.00)	22.00
15	564.90	(98.00)	22.10
16	565.20	(105.00)	22.20
17	565.50	(112.00)	23.10
18	565.20	(119.00)	24.20
19	564.90	(126.00)	24.70
20	564.60	(133.00)	25.00
21	564.30	(140.00)	25.30
22	564.00	(147.00)	26.10
23	564.20	(154.00)	26.60
24	564.30	(161.00)	28.30

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL7006.TXE

Header data from file CCSL7006.

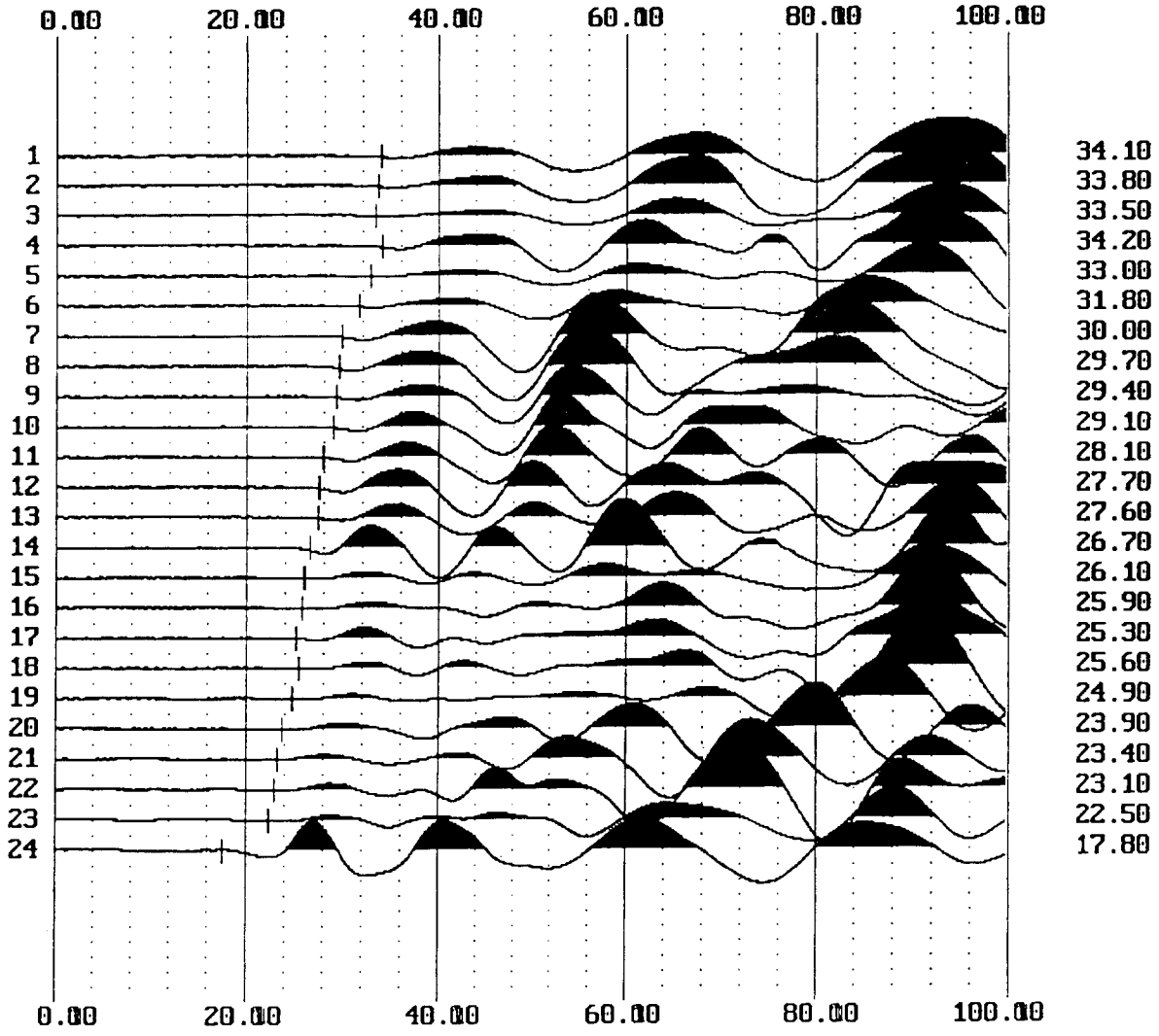
File number:	CCSL7006
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904971032
Operator note:	SHOT POINT 176', PHONE SPACE 7' LINE ALONG DRAINAGE
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	176.0
Shot location Y:	0.0
Shot location Z:	564.2

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1
File: CCSL7006.TXL

Seismic waveform data from file CCSL7006.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL7006.TXE

First Arrival and Elevation Data from CCSL7006.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	564.20	176.00	
1	565.00	0.00	34.10
2	564.70	7.00	33.80
3	564.30	14.00	33.50
4	564.00	(21.00)	34.20
5	563.80	(28.00)	33.00
6	563.60	(35.00)	31.80
7	563.60	(42.00)	30.00
8	563.80	(49.00)	29.70
9	564.00	(56.00)	29.40
10	564.50	(63.00)	29.10
11	564.00	(70.00)	28.10
12	563.70	(77.00)	27.70
13	564.20	(84.00)	27.60
14	564.60	(91.00)	26.70
15	564.90	(98.00)	26.10
16	565.20	(105.00)	25.90
17	565.50	(112.00)	25.30
18	565.20	(119.00)	25.60
19	564.90	(126.00)	24.90
20	564.60	(133.00)	23.90
21	564.30	(140.00)	23.40
22	564.00	(147.00)	23.10
23	564.20	(154.00)	22.50
24	564.30	(161.00)	17.80

CLEAR CREEK SEISMIC SURVEY

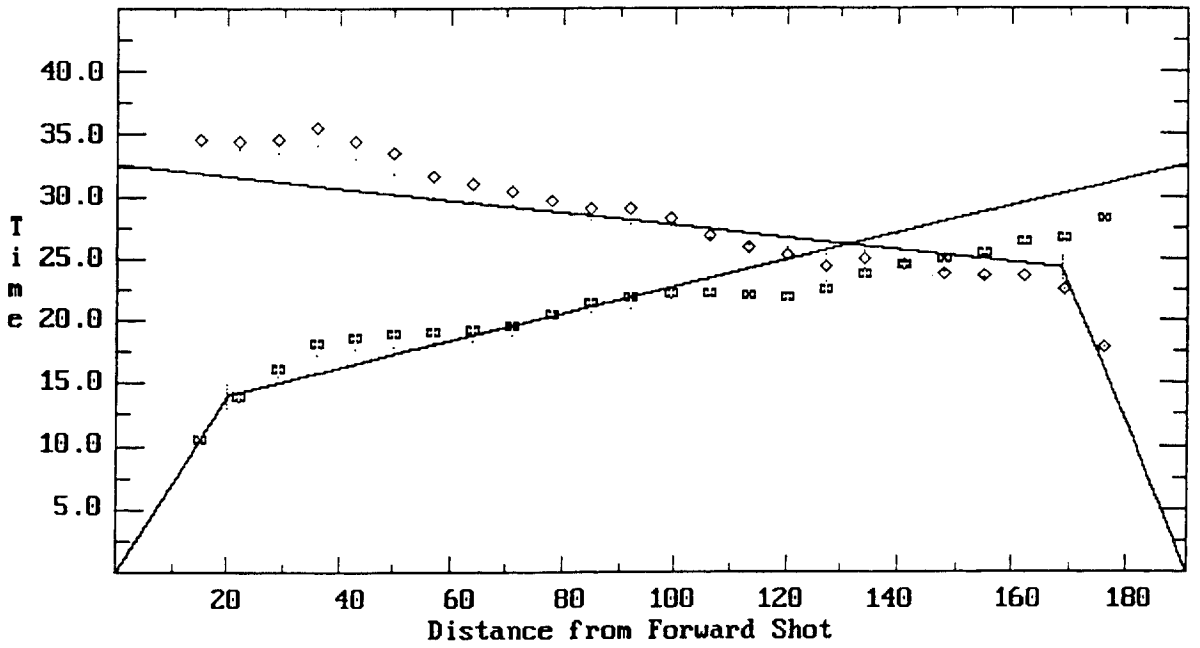
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL7002.TXE	CCSL7006.TXE
Shot Pos:	-15.0	176.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL7002.TXE	CCSL7006.TXE
Shot Pos:	-15.0	176.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1429	324	0.0	4	0.0
Forward	2	9196	558	11.8	1	19.9
Reverse	1	930	149	0.0	4	0.0
Reverse	2	20108	>E3	23.0	1	22.5

CLEAR CREEK SEISMIC SURVEY

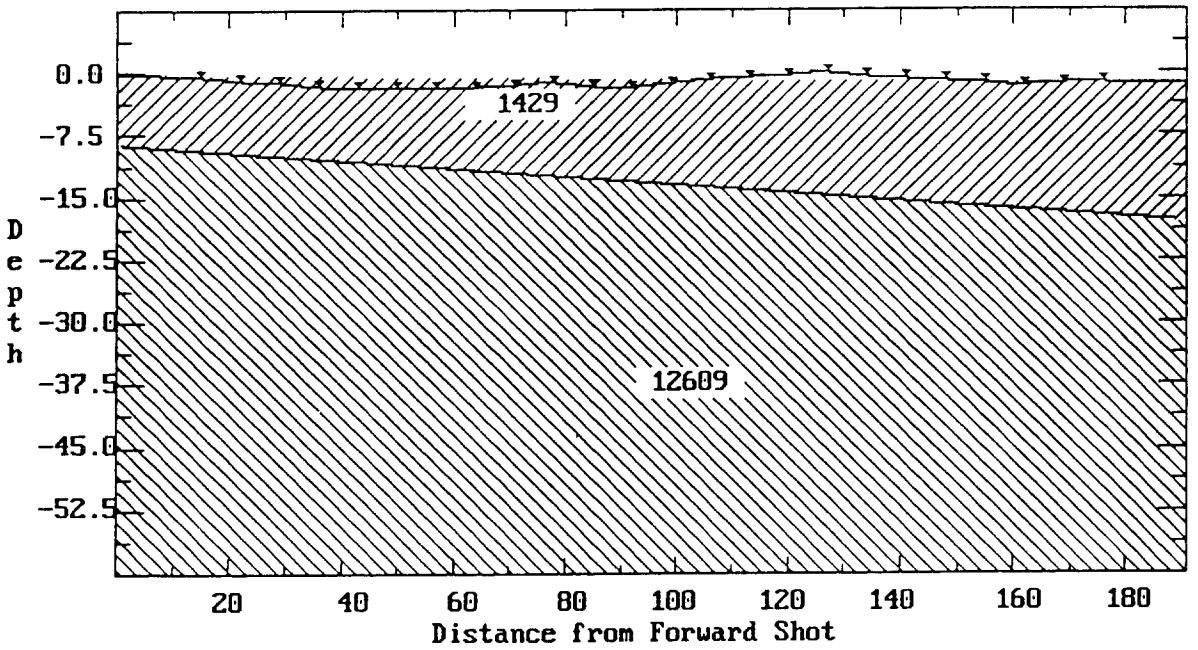
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL7002.TXE	CCSL7006.TXE
Shot Pos:	-15.0	176.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	1429	12609
Dip Angle:	-0.39	-3.21
Averaging Interval:	1- 188	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	565.5	8.5
1	15.0	565.0	8.7
2	22.0	564.7	8.7
3	29.0	564.3	8.7
4	36.0	564.0	8.7
5	43.0	563.8	8.9
6	50.0	563.6	9.0
7	57.0	563.6	9.4
8	64.0	563.8	9.9
9	71.0	564.0	10.5
10	78.0	564.5	11.3
11	85.0	564.0	11.1
12	92.0	563.7	11.2
13	99.0	564.2	12.0
14	106.0	564.6	12.8
15	113.0	564.9	13.4
16	120.0	565.2	14.1
17	127.0	565.5	14.7
18	134.0	565.2	14.8
19	141.0	564.9	14.8
20	148.0	564.6	14.8
21	155.0	564.3	14.9
22	162.0	564.0	14.9
23	169.0	564.2	15.5
24	176.0	564.3	15.9
Rev Shot	0.0	564.2	17.9

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 8

Phone Spacing: 10' Bearing: S 30 E

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	565.8	1200.0	24700.0	16.49	549.3
1	0	565.7	1200.0	24700.0	16.65	549.1
2	10	565.7	1200.0	24700.0	16.82	548.9
3	20	565.8	1200.0	24700.0	17.09	548.7
4	30	566.2	1200.0	24700.0	17.66	548.5
5	40	566.4	1200.0	24700.0	18.04	548.4
6	50	566.5	1200.0	24700.0	18.31	548.2
7	60	566.5	1200.0	24700.0	18.48	548.0
8	70	566.5	1200.0	24700.0	18.66	547.8
9	80	566.3	1200.0	24700.0	18.63	547.7
10	90	566.2	1200.0	24700.0	18.70	547.5
11	100	565.9	1200.0	24700.0	18.57	547.3
12	110	565.8	1200.0	24700.0	18.65	547.2
13	120	565.7	1200.0	24700.0	18.72	547.0
14	130	565.6	1200.0	24700.0	18.79	546.8
15	140	565.6	1200.0	24700.0	18.87	546.7
16	150	565.4	1200.0	24700.0	18.94	546.5
17	160	565.3	1200.0	24700.0	19.01	546.3
18	170	565.2	1200.0	24700.0	19.08	546.1
19	180	565.1	1200.0	24700.0	19.16	545.9
20	190	565.0	1200.0	24700.0	19.23	545.8
21	200	565.0	1200.0	24700.0	19.40	545.6
22	210	564.9	1200.0	24700.0	19.47	545.4
23	220	564.8	1200.0	24700.0	19.55	545.3
24	230	564.4	1200.0	24700.0	19.32	545.1
SP+15	245	562.8	1200.0	24700.0	18.98	543.8

** error factor +-5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL8002.TXE

Header data from file CCSL8002.

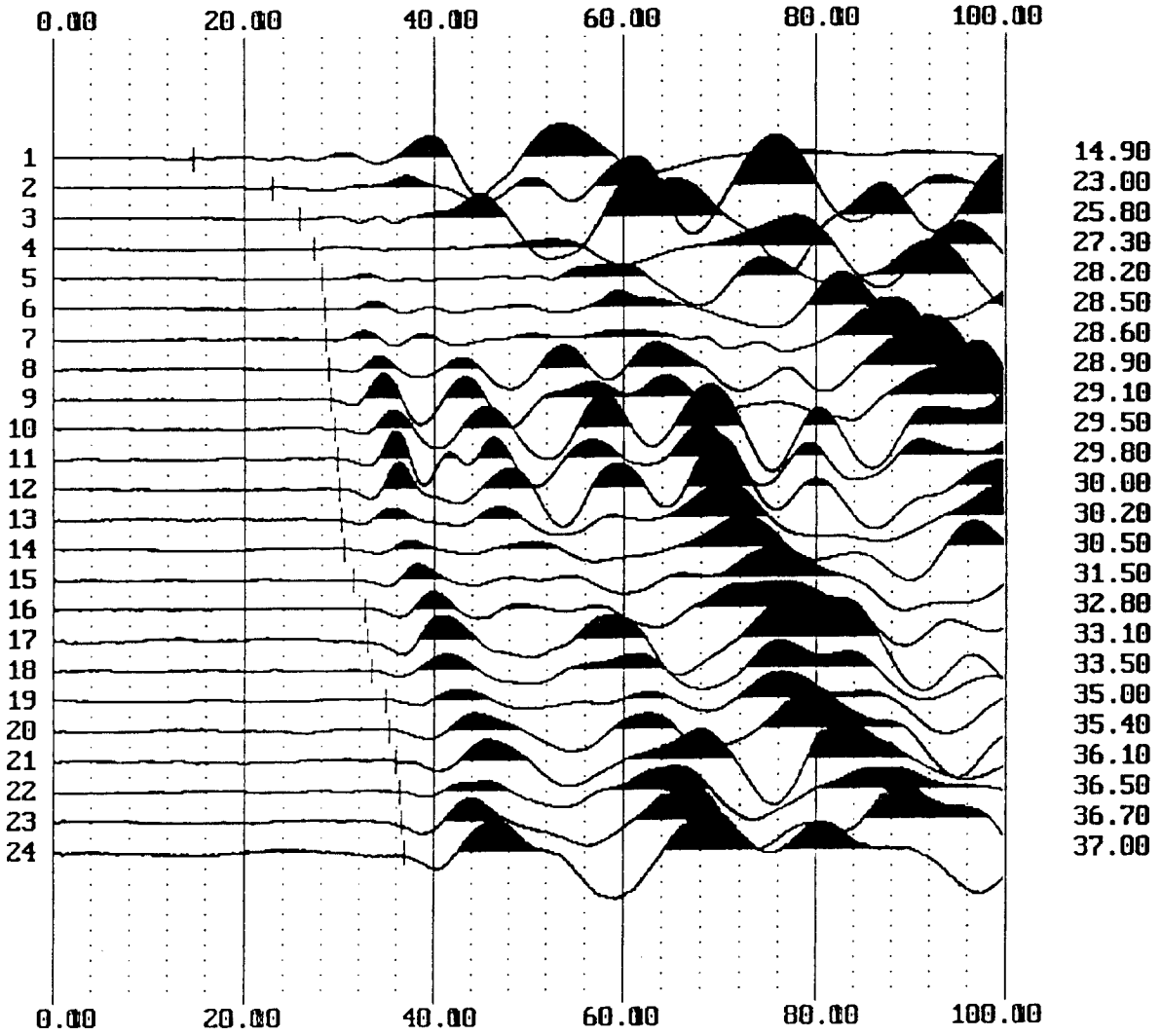
File number:	CCSL8002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904971344
Operator note:	SHOT POINT -15', PHONE SPACE 10', LINE IN FINE SAND
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	565.8

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL8002.TXE

Seismic waveform data from file CCSL8002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL8002.TXE

First Arrival and Elevation Data from CCSL8002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	565.80	-15.00	
1	565.70	0.00	14.90
2	565.70	10.00	23.00
3	565.80	20.00	25.80
4	566.20	(30.00)	27.30
5	566.40	(40.00)	28.20
6	566.50	(50.00)	28.50
7	566.50	(60.00)	28.60
8	566.50	(70.00)	28.90
9	566.30	(80.00)	29.10
10	566.20	(90.00)	29.50
11	565.90	(100.00)	29.80
12	565.80	(110.00)	30.00
13	565.70	(120.00)	30.20
14	565.60	(130.00)	30.50
15	565.50	(140.00)	31.50
16	565.40	(150.00)	32.80
17	565.30	(160.00)	33.10
18	565.20	(170.00)	33.50
19	565.10	(180.00)	35.00
20	565.00	(190.00)	35.40
21	565.00	(200.00)	36.10
22	564.90	(210.00)	36.50
23	564.80	(220.00)	36.70
24	564.40	(230.00)	37.00

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL8005.TXE

Header data from file CCSL8005.

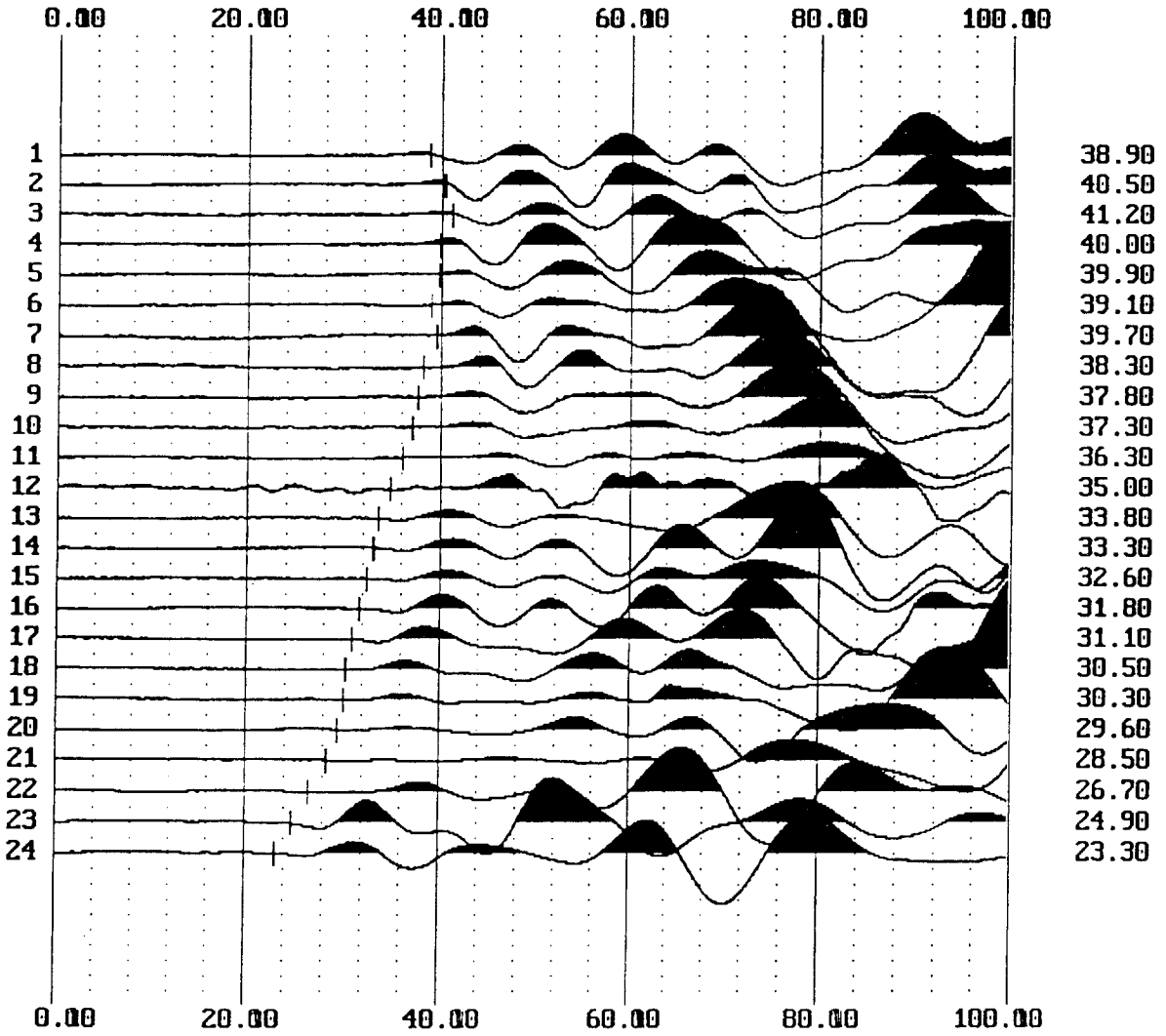
File number:	CCSL8005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904971457
Operator note:	SHOT POINT 245', PHONE SPACE 10', LINE IN FINE SAND
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	245.0
Shot location Y:	0.0
Shot location Z:	563.8

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL8005.TXE

Seismic waveform data from file CCSL8005.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File: CCSL8005.TXE

First Arrival and Elevation Data from CCSL8005.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	563.80	245.00	
1	565.70	0.00	38.90
2	565.70	10.00	40.50
3	565.80	20.00	41.20
4	566.20	(30.00)	40.00
5	566.40	(40.00)	39.90
6	566.50	(50.00)	39.10
7	566.50	(60.00)	39.70
8	566.50	(70.00)	38.30
9	566.30	(80.00)	37.80
10	566.20	(90.00)	37.30
11	565.90	(100.00)	36.30
12	565.80	(110.00)	35.00
13	565.70	(120.00)	33.80
14	565.60	(130.00)	33.30
15	565.50	(140.00)	32.60
16	565.40	(150.00)	31.80
17	565.30	(160.00)	31.10
18	565.20	(170.00)	30.50
19	565.10	(180.00)	30.30
20	565.00	(190.00)	29.60
21	565.00	(200.00)	28.50
22	564.90	(210.00)	26.70
23	564.80	(220.00)	24.90
24	564.40	(230.00)	23.30

CLEAR CREEK SEISMIC SURVEY

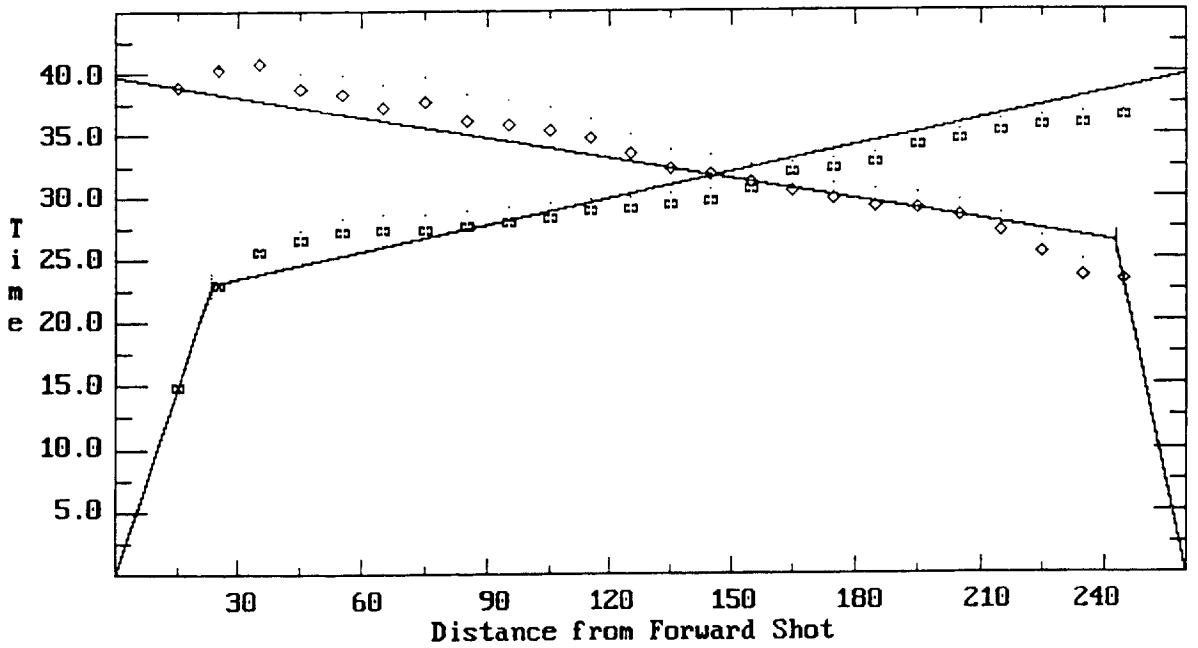
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.1

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL8002.TXE	CCSL8005.TXE
Shot Pos:	-15.0	245.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL8002.TXE	CCSL8005.TXE
Shot Pos:	-15.0	245.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1007	0	0.0	0	0.0
Forward	2	14194	607	21.4	0	23.1
Reverse	1	644	0	0.0	0	0.0
Reverse	2	18079	973	25.3	0	16.9

CLEAR CREEK SEISMIC SURVEY

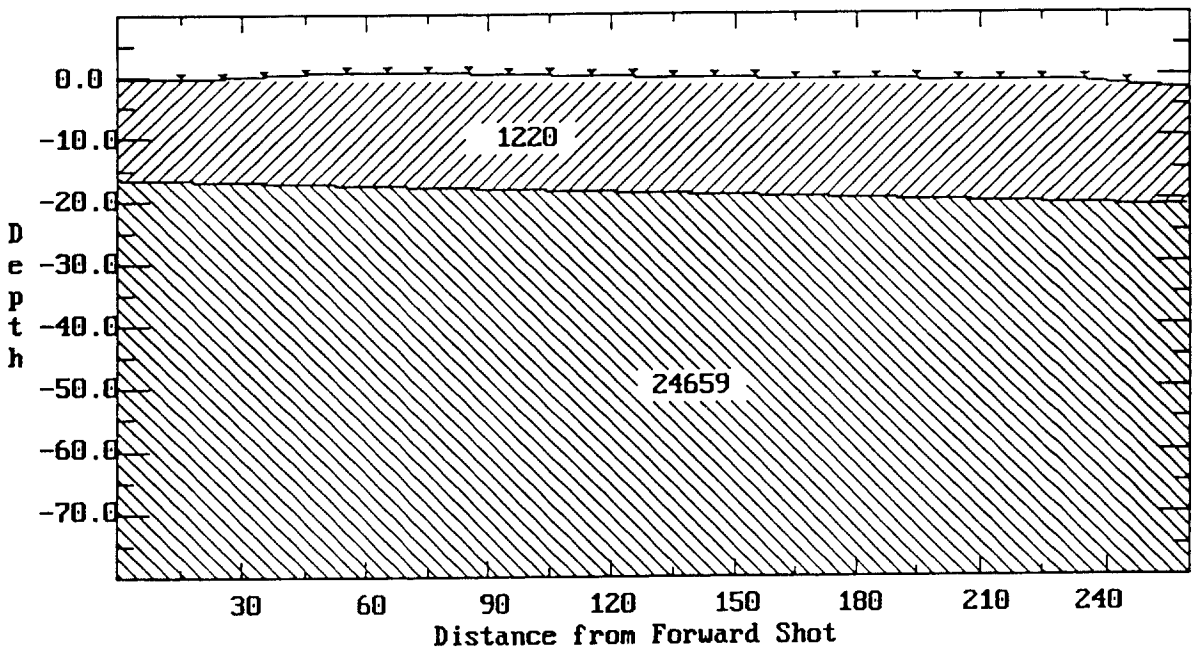
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL8002.TXE	CCSL8005.TXE
Shot Pos:	-15.0	245.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

16 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	1220	24659
Dip Angle:	-0.44	-1.43
Averaging Interval:	1- 259	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	565.8	16.5
1	15.0	565.7	16.6
2	25.0	565.7	16.8
3	35.0	565.8	17.1
4	45.0	566.2	17.7
5	55.0	566.4	18.0
6	65.0	566.5	18.3
7	75.0	566.5	18.5
8	85.0	566.5	18.7
9	95.0	566.3	18.6
10	105.0	566.2	18.7
11	115.0	565.9	18.6
12	125.0	565.8	18.6
13	135.0	565.7	18.7
14	145.0	565.6	18.8
15	155.0	565.5	18.9
16	165.0	565.4	18.9
17	175.0	565.3	19.0
18	185.0	565.2	19.1
19	195.0	565.1	19.2
20	205.0	565.0	19.2
21	215.0	565.0	19.4
22	225.0	564.9	19.5
23	235.0	564.8	19.5
24	245.0	564.4	19.3
Rev Shot	0.0	563.8	21.0

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 9

Phone Spacing: 9' Bearing: S 30 E

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	564.2	1300.0	26993.0	20.7	543.5
1	0	564.2	1300.0	26993.0	20.2	544.0
2	9	564.4	1300.0	26993.0	20.2	544.2
3	18	564.2	1300.0	26993.0	19.7	544.5
4	27	564.2	1300.0	26993.0	19.5	544.7
5	36	563.6	1300.0	26993.0	18.6	545.0
6	45	562.9	1300.0	26993.0	17.2	545.7
7	54	562.2	1300.0	26993.0	16.7	545.5
8	63	561.8	1300.0	26993.0	16.1	545.7
9	72	562.2	1300.0	26993.0	16.2	546.0
10	81	562.7	1300.0	26993.0	16.5	546.2
11	90	563.2	1300.0	26993.0	16.7	546.5
12	99	563.4	1300.0	26993.0	16.7	546.7
13	108	563.7	1300.0	26993.0	16.7	547.0
14	117	564.0	1300.0	26993.0	16.8	547.2
15	126	564.3	1300.0	26993.0	16.8	547.5
16	135	546.6	1300.0	26993.0	16.9	529.7
17	144	564.3	1300.0	26993.0	16.3	548.0
18	153	564.1	1300.0	26993.0	15.9	548.2
19	162	563.8	1300.0	26993.0	15.3	548.5
20	171	564.0	1300.0	26993.0	15.3	548.7
21	180	564.2	1300.0	26993.0	15.2	549.0
22	189	564.4	1300.0	26993.0	15.2	549.2
23	198	564.3	1300.0	26993.0	14.8	549.5
24	207	564.3	1300.0	26993.0	14.6	549.7
SP+15	222	563.0	1300.0	26993.0	14.1	548.9

** error factor +- 4.5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.1
File: CCSL9002.TXE

Header data from file CCSL9002.

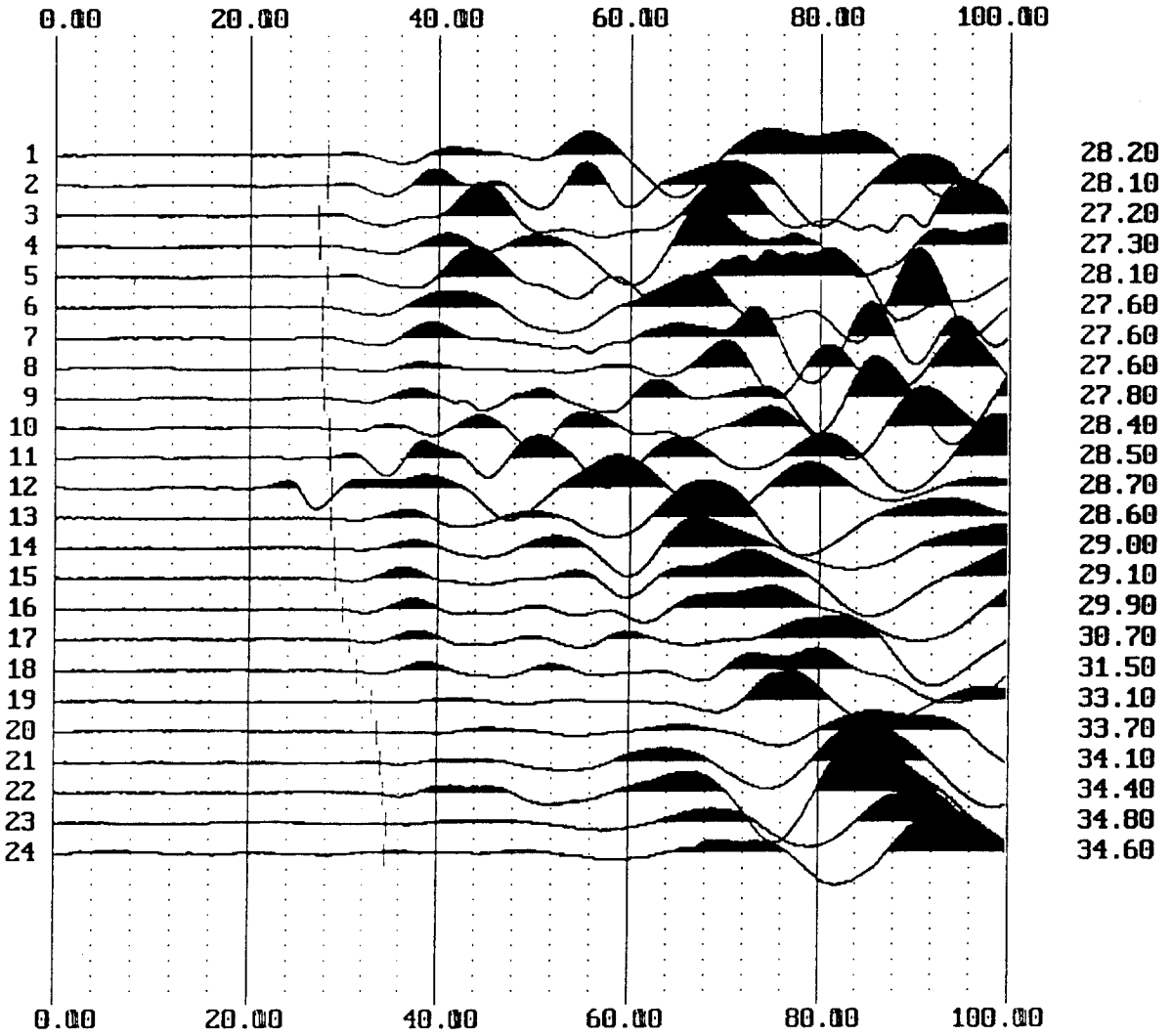
File number:	CCSL9002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904971559
Operator note:	SHOT POINT -15',PHONE SPACE 9', LINE IN FINE SAND
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	564.2

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCSL9002.TXE

Seismic waveform data from file CCSL9002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCSL9002.TXE

First Arrival and Elevation Data from CCSL9002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	564.20	-15.00	
1	564.20	0.00	28.20
2	564.40	9.00	28.10
3	564.20	18.00	27.20
4	564.20	(27.00)	27.30
5	563.60	(36.00)	28.10
6	562.40	(45.00)	27.60
7	562.20	(54.00)	27.60
8	561.80	(63.00)	27.60
9	562.20	(72.00)	27.80
10	562.70	(81.00)	28.40
11	563.20	(90.00)	28.50
12	563.40	(99.00)	28.70
13	563.70	(108.00)	28.60
14	564.00	(117.00)	29.00
15	564.30	(126.00)	29.10
16	564.60	(135.00)	29.90
17	564.30	(144.00)	30.70
18	564.10	(153.00)	31.50
19	563.80	(162.00)	33.10
20	564.00	(171.00)	33.70
21	564.20	(180.00)	34.10
22	564.40	(189.00)	34.40
23	564.30	(198.00)	34.80
24	564.30	(207.00)	34.60

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJFCT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCSL9005.TXE

Header data from file CCSL9005.

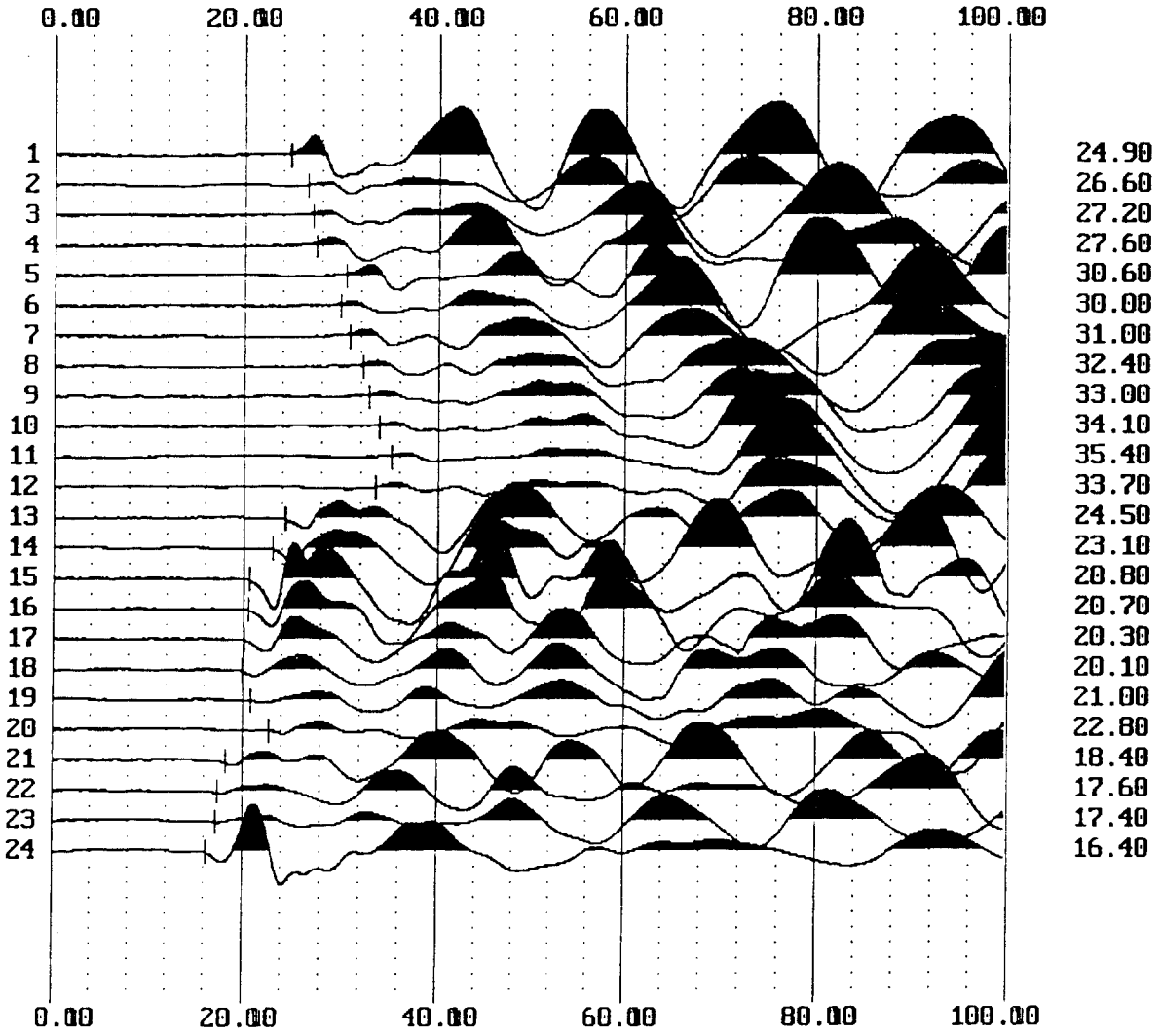
File number:	CCSL9005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0904971607
Operator note:	SHOT POINT 222', PHONE SPACE 9', LINE IN FINE SAND
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	222.0
Shot location Y:	0.0
Shot location Z:	563.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCSL9005.TXE

Seismic waveform data from file CCSL9005.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCSL9005.TXE

First Arrival and Elevation Data from CCSL9005.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	563.00	222.00	
1	564.20	0.00	24.90
2	564.40	9.00	26.60
3	564.20	18.00	27.20
4	564.20	(27.00)	27.60
5	563.60	(36.00)	30.60
6	562.40	(45.00)	30.00
7	562.20	(54.00)	31.00
8	561.80	(63.00)	32.40
9	562.20	(72.00)	33.00
10	562.70	(81.00)	34.10
11	563.20	(90.00)	35.40
12	563.40	(99.00)	33.70
13	563.70	(108.00)	24.50
14	564.00	(117.00)	23.10
15	564.30	(126.00)	20.80
16	564.60	(135.00)	20.70
17	564.30	(144.00)	20.30
18	564.10	(153.00)	20.10
19	563.80	(162.00)	21.00
20	564.00	(171.00)	22.80
21	564.20	(180.00)	18.40
22	564.40	(189.00)	17.60
23	564.30	(198.00)	17.40
24	564.30	(207.00)	16.40

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL9002.TXE	CCSL9005.TXE
Shot Pos:	-15.0	222.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1363	440	0.0	10	0.0
Forward	2	77222	>E3	30.3	2	42.0
Reverse	1	1832	714	0.0	10	0.0
Reverse	2	16365	>E3	18.8	2	38.9

CLEAR CREEK SEISMIC SURVEY

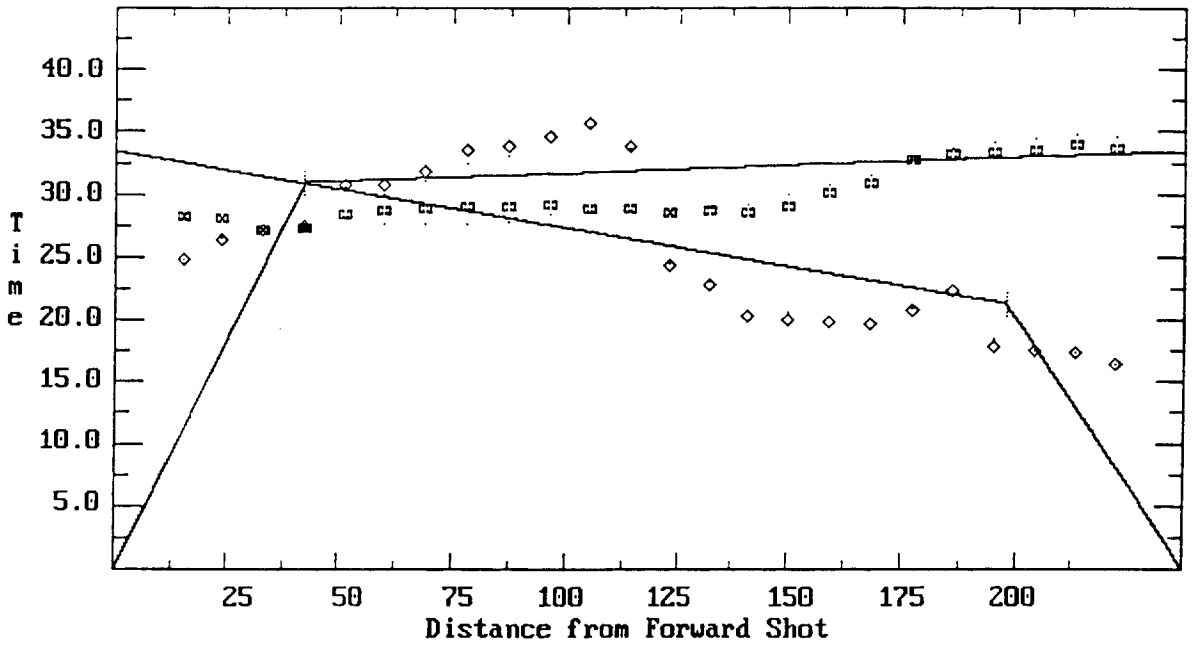
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL9002.TXE	CCSL9005.TXE
Shot Pos:	-15.0	222.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

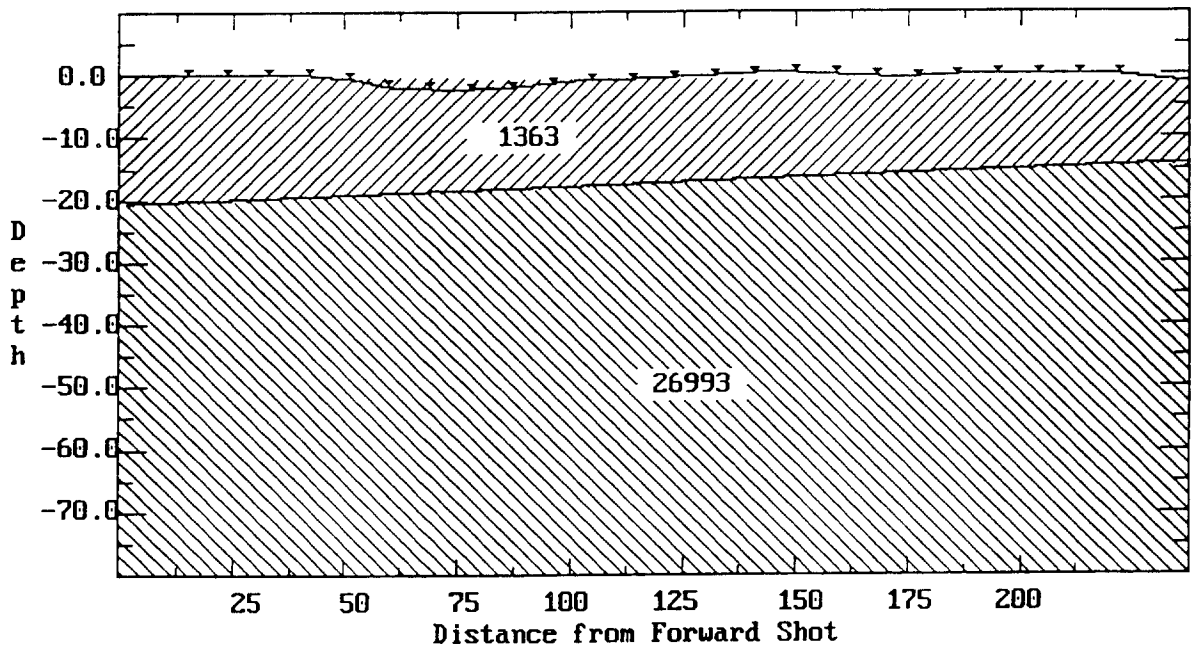
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCSL9002.TXE	CCSL9005.TXE
Shot Pos:	-15.0	222.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	1363	26993
Dip Angle:	-0.29	1.30
Averaging Interval:	2- 237	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	564.2	20.7
1	15.0	564.2	20.2
2	24.0	564.4	20.2
3	33.0	564.2	19.7
4	42.0	564.2	19.5
5	51.0	563.6	18.6
6	60.0	562.4	17.2
7	69.0	562.2	16.7
8	78.0	561.8	16.1
9	87.0	562.2	16.2
10	96.0	562.7	16.5
11	105.0	563.2	16.7
12	114.0	563.4	16.7
13	123.0	563.7	16.7
14	132.0	564.0	16.8
15	141.0	564.3	16.8
16	150.0	564.6	16.9
17	159.0	564.3	16.3
18	168.0	564.1	15.9
19	177.0	563.8	15.3
20	186.0	564.0	15.3
21	195.0	564.2	15.2
22	204.0	564.4	15.2
23	213.0	564.3	14.8
24	222.0	564.3	14.6
Rev Shot	0.0	563.0	14.1

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 10

Phone Spacing: 5' Bearing: N 30 W

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-15	-15	560.0	852.0	23433.0	7.3	552.7
1	0	565.1	852.0	23433.0	11.3	553.8
2	5	565.7	852.0	23433.0	11.5	554.2
3	10	566.1	852.0	23433.0	11.5	554.6
4	15	566.2	852.0	23433.0	11.3	554.9
5	20	566.3	852.0	23433.0	11.0	555.3
6	25	566.1	852.0	23433.0	10.4	555.7
7	30	566.3	852.0	23433.0	10.3	556.0
8	35	566.4	852.0	23433.0	10.0	556.4
9	40	567.0	852.0	23433.0	10.2	556.8
10	45	567.4	852.0	23433.0	10.2	557.2
11	50	567.6	852.0	23433.0	10.1	557.5
12	55	566.9	852.0	23433.0	9.0	557.9
13	60	567.3	852.0	23433.0	9.0	558.3
14	65	567.9	852.0	23433.0	9.3	558.6
15	70	568.3	852.0	23433.0	9.3	559.0
16	75	567.7	852.0	23433.0	8.3	559.4
17	80	567.5	852.0	23433.0	7.7	559.8
18	85	567.3	852.0	23433.0	7.2	560.1
SP+15	100	567.3	852.0	23433.0	-1.2	568.5

** error factor +- 2.5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS10-2.TXE

Header data from file CCS10011.

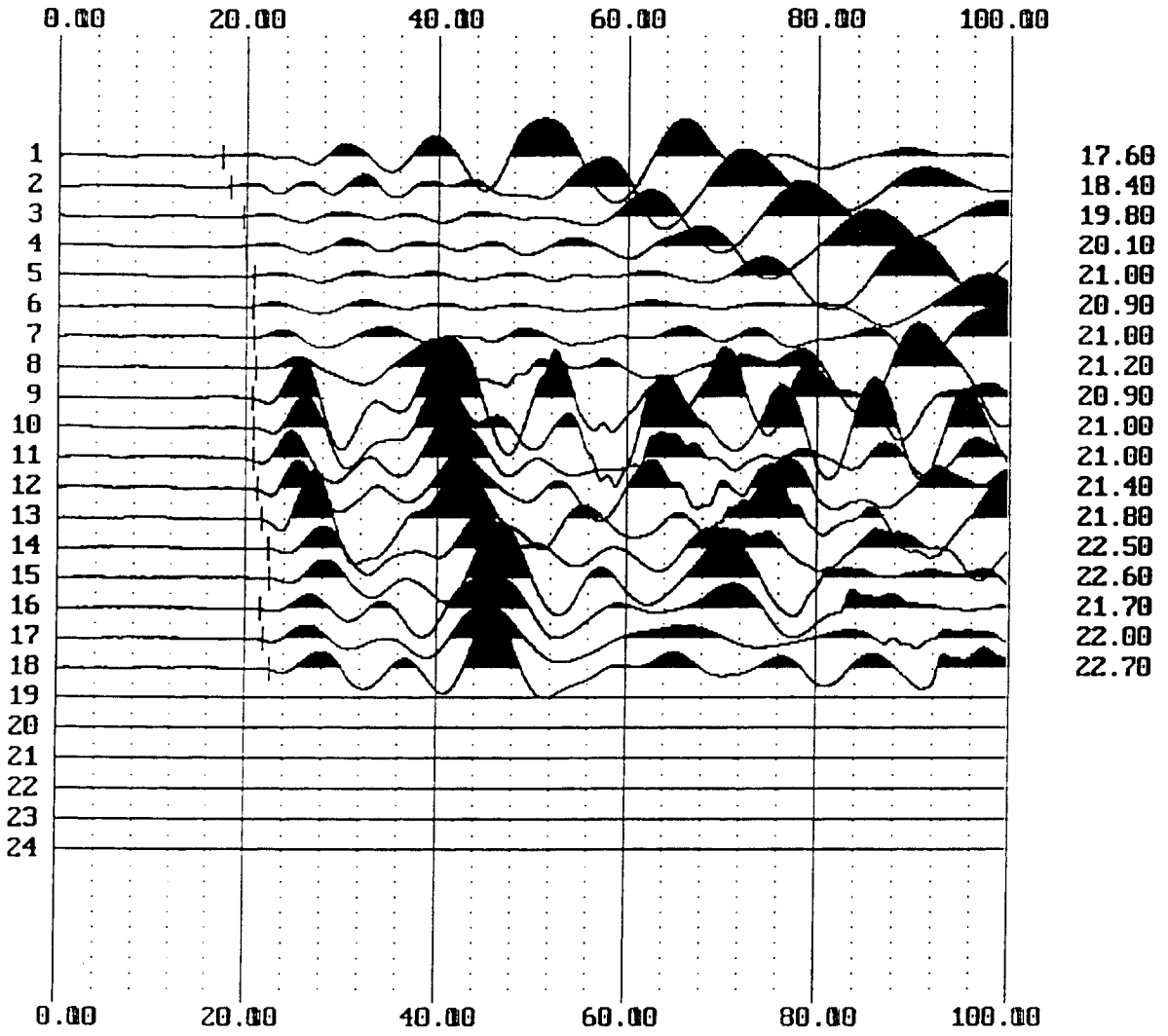
File number:	CCS10011
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0908970920
Operator note:	SHOT POINT -15', PHONE SPACING 5', 18 CHANNELS ONLY
Manufacturer code:	BISON-2
Number of channels:	18
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-15.0
Shot location Y:	0.0
Shot location Z:	560.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS10-2.TXE

Seismic waveform data from file CCS10011.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS10-2.TXE

First Arrival and Elevation Data from CCS10-2.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	560.00	-15.00	
1	565.10	(0.00)	17.60
2	565.70	5.00	18.40
3	566.10	10.00	19.80
4	566.20	(15.00)	20.10
5	566.30	(20.00)	21.00
6	566.10	25.00	20.90
7	566.30	30.00	21.00
8	566.40	35.00	21.20
9	567.00	40.00	20.90
10	567.40	(45.00)	21.00
11	567.60	(50.00)	21.00
12	566.90	(55.00)	21.40
13	567.30	(60.00)	21.80
14	567.90	(65.00)	22.50
15	568.30	(70.00)	22.60
16	567.70	(75.00)	21.70
17	567.50	(80.00)	22.00
18	567.30	(85.00)	22.70

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

24 Nov 97
REFRACT 3.13
File: CCS10-5.TXE

Header data from file CCS10015.

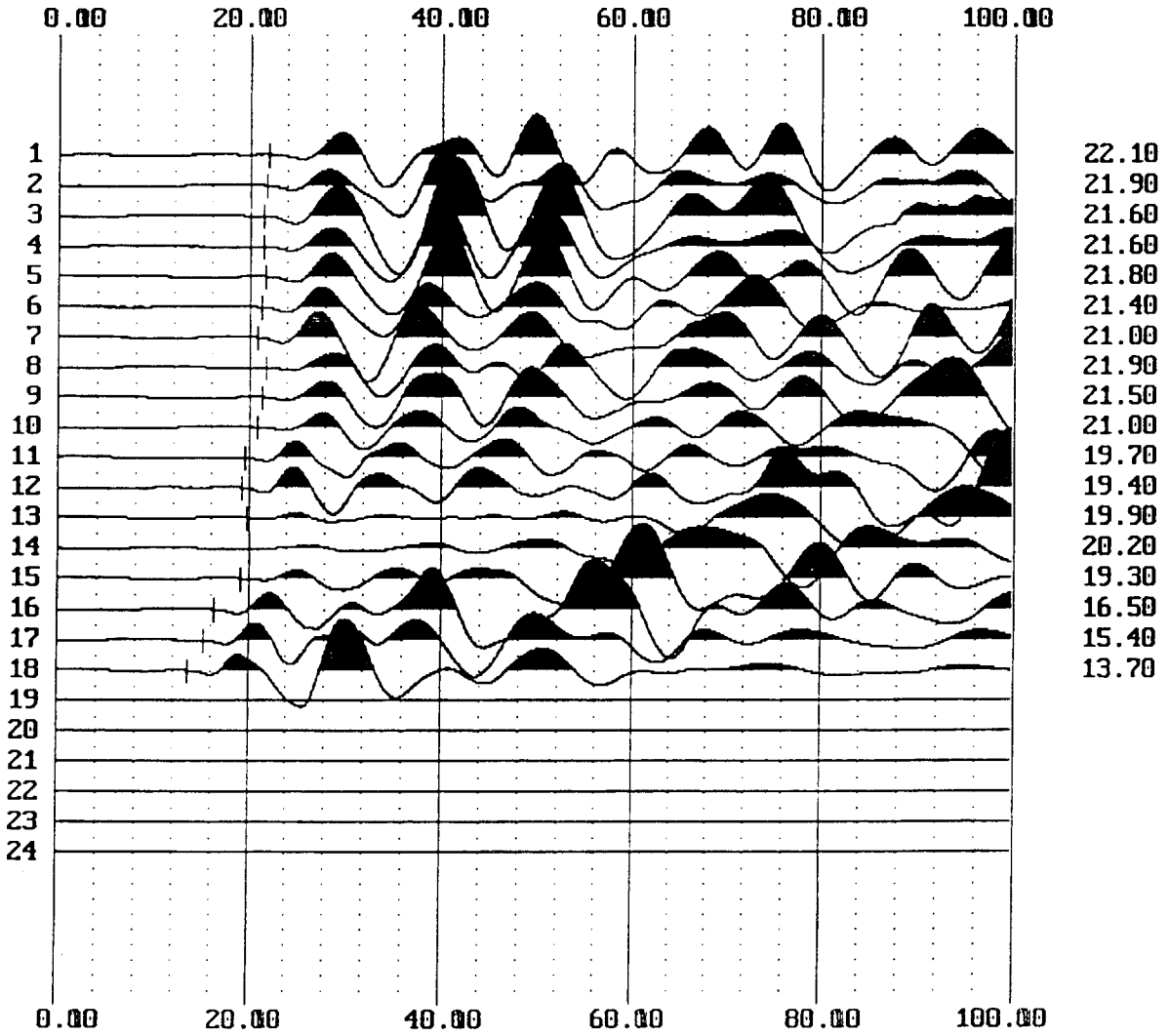
File number:	CCS10015
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0908970929
Operator note:	SHOT POINT
Manufacturer code:	BISON-2
Number of channels:	18
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	100.0
Shot location Y:	0.0
Shot location Z:	567.3

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

24 Nov 97
REFRACT 3.13
File: CCS10-5.TXE

Seismic waveform data from file CCS10015.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

24 Nov 97
REFRACT 3.13
File: CCS10-5.TXE

First Arrival and Elevation Data from CCS10-5.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	567.30	100.00	
1	565.10	0.00	22.10
2	565.70	5.00	21.90
3	566.10	10.00	21.60
4	566.20	(15.00)	21.60
5	566.30	(20.00)	21.80
6	566.10	(25.00)	21.40
7	566.30	(30.00)	21.00
8	566.40	(35.00)	21.90
9	567.00	(40.00)	21.50
10	567.40	(45.00)	21.00
11	567.60	(50.00)	19.70
12	566.90	(55.00)	19.40
13	567.30	(60.00)	19.90
14	567.90	(65.00)	20.20
15	568.30	(70.00)	19.30
16	567.70	(75.00)	16.50
17	567.50	(80.00)	15.40
18	567.30	(85.00)	13.70

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

24 Nov 97
REFRACT 3.1

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward CCS10-2.TXE	Reverse CCS10-5.TXE
Shot Pos:	-15.0	100.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	852	0	0.0	0	0.0
Forward	2	33306	>E3	17.1	1	15.0
Reverse	1	1095	0	0.0	0	0.0
Reverse	2	18076	>E3	14.2	1	16.6

CLEAR CREEK SEISMIC SURVEY

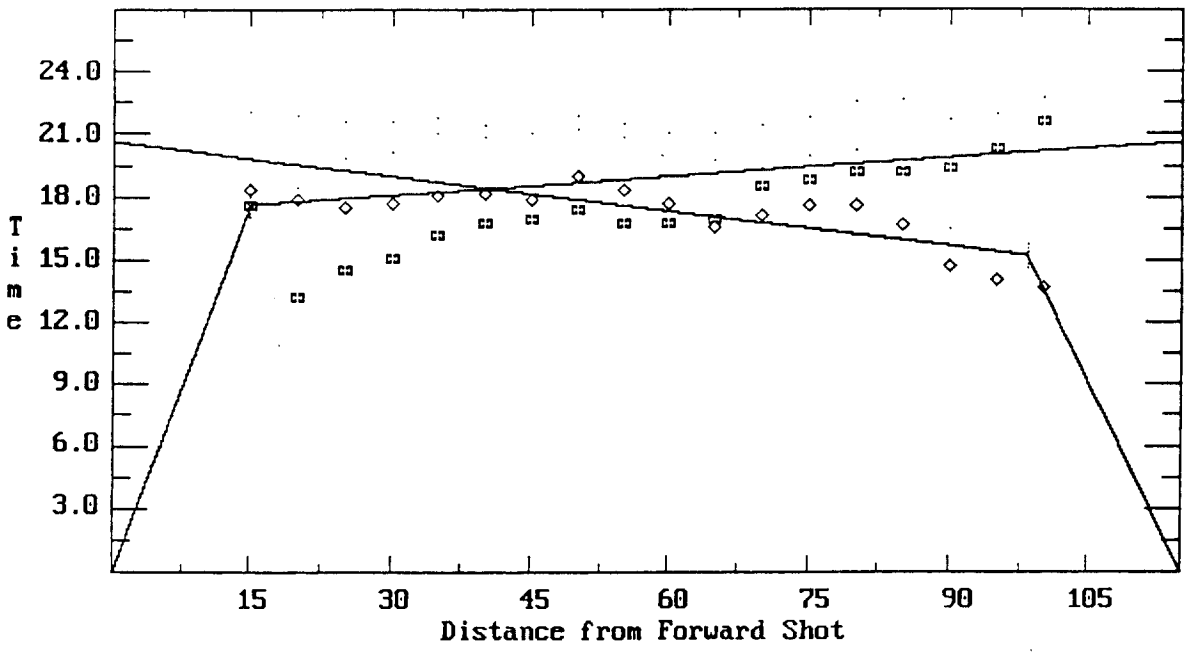
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

24 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS10-2.TXE	CCS10-5.TXE
Shot Pos:	-15.0	100.0

Time-Distance Plot for



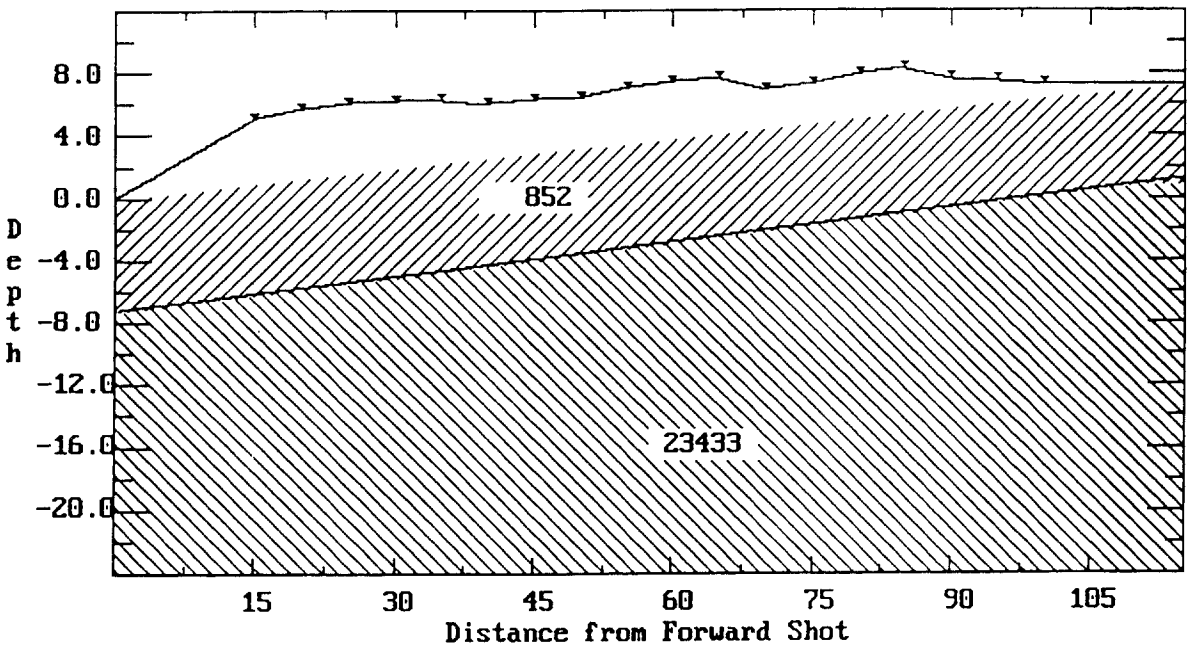
CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

24 Nov 97
REFRACT 3.13
File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS10-2.TXE	CCS10-5.TXE
Shot Pos:	-15.0	100.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

24 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	852	23433
Dip Angle:	3.64	7.90
Averaging Interval:	0- 115	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	560.0	7.3
1	15.0	565.1	11.3
2	20.0	565.7	11.5
3	25.0	566.1	11.5
4	30.0	566.2	11.3
5	35.0	566.3	11.0
6	40.0	566.1	10.4
7	45.0	566.3	10.3
8	50.0	566.4	10.0
9	55.0	567.0	10.2
10	60.0	567.4	10.2
11	65.0	567.6	10.1
12	70.0	566.9	9.0
13	75.0	567.3	9.0
14	80.0	567.9	9.3
15	85.0	568.3	9.3
16	90.0	567.7	8.3
17	95.0	567.5	7.7
18	100.0	567.3	7.2
Rev Shot	0.0	567.3	-1.2

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 11

Phone Spacing: 10' Bearing: N 73 E

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Apparent Bedrock ** (ft)	Apparent Bedrock Elevation (ft)
SP-25	-25	565.3	1046.0	13700.0	12.1	553.2
1	0	565.2	1046.0	13700.0	12.0	553.2
2	10	565.2	1046.0	13700.0	12.0	553.2
3	20	565.3	1046.0	13700.0	12.1	553.2
4	30	565.4	1046.0	13700.0	12.3	553.1
5	40	565.5	1046.0	13700.0	12.4	553.1
6	50	565.6	1046.0	13700.0	12.5	553.1
7	60	565.7	1046.0	13700.0	12.6	553.1
8	70	565.8	1046.0	13700.0	12.7	553.1
9	80	565.9	1046.0	13700.0	12.8	553.1
10	90	567.2	1046.0	13700.0	14.1	553.1
11	100	568.0	1046.0	13700.0	15.0	553.0
12	110	567.7	1046.0	13700.0	14.7	553.0
13	120	567.2	1046.0	13700.0	14.2	553.0
14	130	566.8	1046.0	13700.0	13.8	553.0
15	140	566.4	1046.0	13700.0	13.4	553.0
16	150	565.8	1046.0	13700.0	12.8	553.0
17	160	565.6	1046.0	13700.0	12.6	553.0
18	170	565.2	1046.0	13700.0	12.3	552.9
19	180	565.0	1046.0	13700.0	12.1	552.9
20	190	564.8	1046.0	13700.0	11.9	552.9
21	200	564.6	1046.0	13700.0	11.7	552.9
22	210	564.4	1046.0	13700.0	11.5	552.9
23	220	564.2	1046.0	13700.0	11.3	552.9
24	230	564.0	1046.0	13700.0	11.1	552.9
SP+25	255	564.0	1046.0	13700.0	12.5	551.5

** error factor +-5 feet

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS11002.TXE

Header data from file CCS11002.

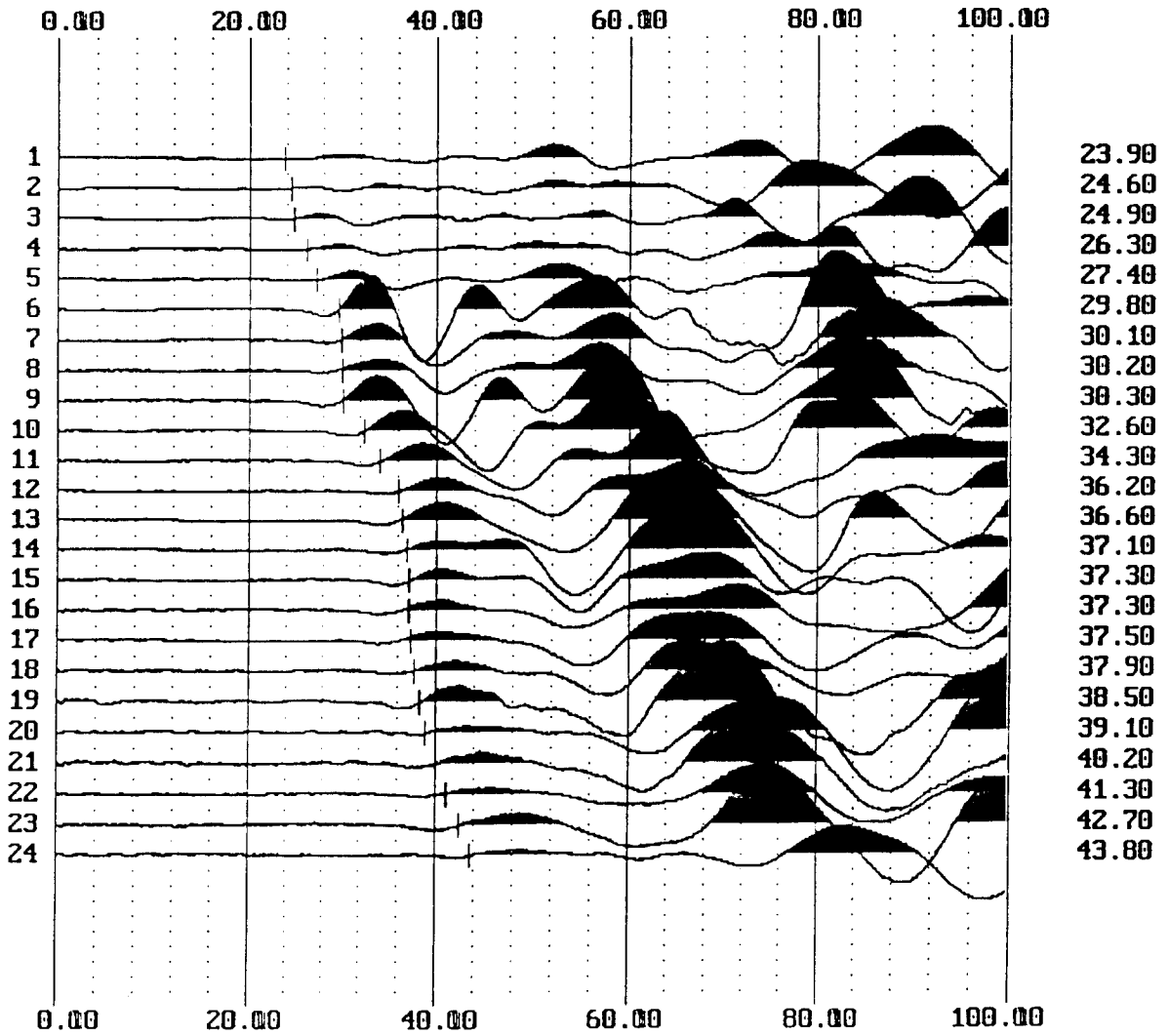
File number:	CCS1102
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0908971004
Operator note:	SHOT POINT -25', PHONE SPACE 10'
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-25.0
Shot location Y:	0.0
Shot location Z:	565.3

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS11002.TXE

Seismic waveform data from file CCS11002.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS11002.TXE

First Arrival and Elevation Data from CCS11002.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	565.30	-25.00	
1	565.20	0.00	23.90
2	565.20	10.00	24.60
3	565.30	20.00	24.90
4	565.40	(30.00)	26.30
5	565.50	(40.00)	27.40
6	565.60	(50.00)	29.80
7	565.70	(60.00)	30.10
8	565.80	(70.00)	30.20
9	565.90	(80.00)	30.30
10	567.20	(90.00)	32.60
11	568.00	(100.00)	34.30
12	567.70	(110.00)	36.20
13	567.20	(120.00)	36.60
14	566.80	(130.00)	37.10
15	566.40	(140.00)	37.30
16	565.80	(150.00)	37.30
17	565.60	(160.00)	37.50
18	565.20	(170.00)	37.90
19	565.00	(180.00)	38.50
20	564.80	(190.00)	39.10
21	564.60	(200.00)	40.20
22	564.40	(210.00)	41.30
23	564.20	(220.00)	42.70
24	564.00	(230.00)	43.80

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS11005.TXE

Header data from file CCS11005.

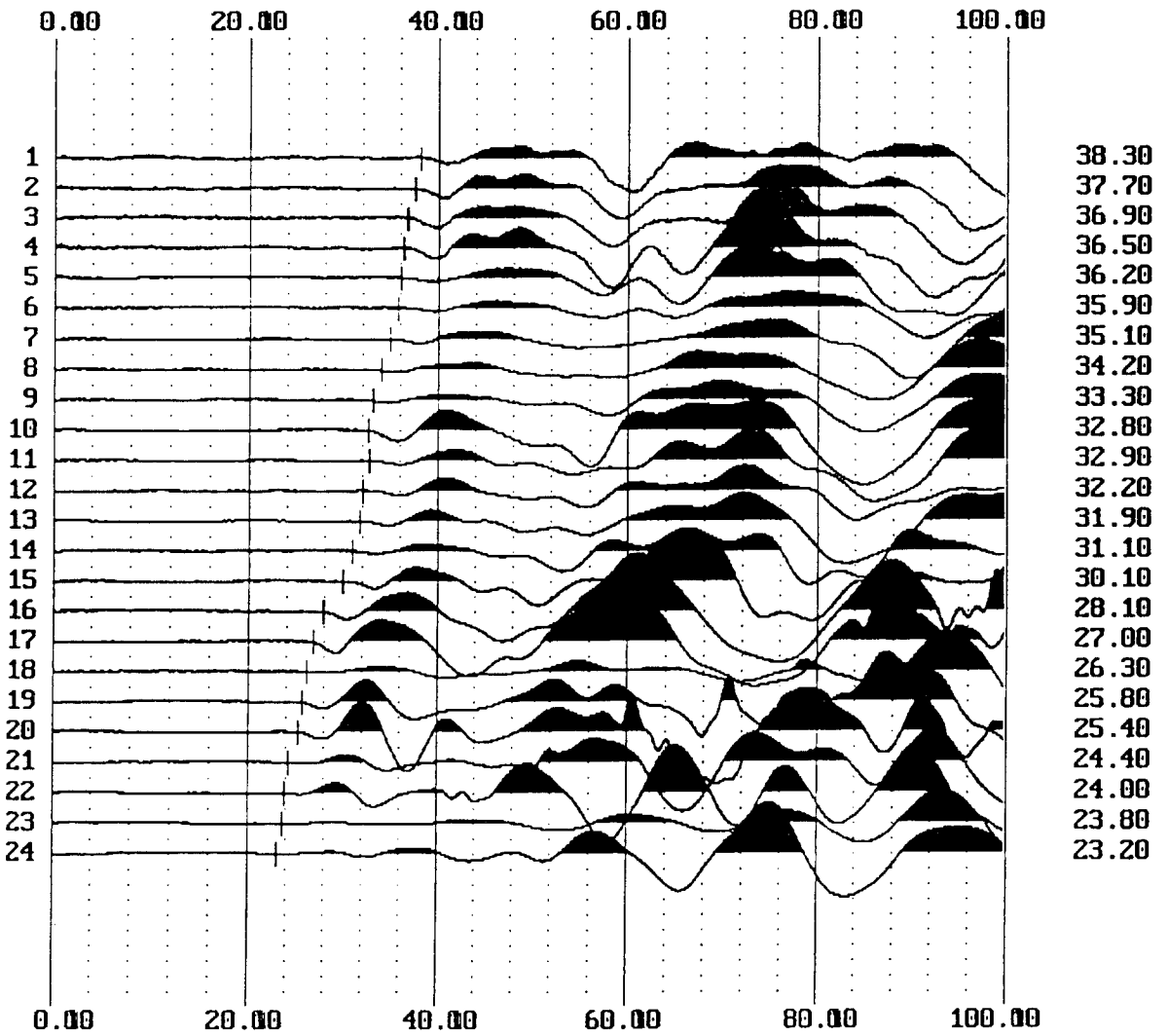
File number:	CCS11005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0908971013
Operator note:	SHOT POINT 255', PHONE SPACE 10'
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	255.0
Shot location Y:	0.0
Shot location Z:	564.0

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS11005.TXE

Seismic waveform data from file CCS11005.



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File: CCS11005.TXE

First Arrival and Elevation Data from CCS11005.TXE

Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	564.00	255.00	
1	565.20	0.00	38.30
2	565.20	10.00	37.70
3	565.30	20.00	36.90
4	565.40	(30.00)	36.50
5	565.50	(40.00)	36.20
6	565.60	(50.00)	35.90
7	565.70	(60.00)	35.10
8	565.80	(70.00)	34.20
9	565.90	(80.00)	33.30
10	567.20	(90.00)	32.80
11	568.00	(100.00)	32.90
12	567.70	(110.00)	32.20
13	567.20	(120.00)	31.90
14	566.80	(130.00)	31.10
15	566.40	(140.00)	30.10
16	565.80	(150.00)	28.10
17	565.60	(160.00)	27.00
18	565.20	(170.00)	26.30
19	565.00	(180.00)	25.80
20	564.80	(190.00)	25.40
21	564.60	(200.00)	24.40
22	564.40	(210.00)	24.00
23	564.20	(220.00)	23.80
24	564.00	(230.00)	23.20

CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS11002.TXE	CCS11005.TXE
Shot Pos:	-25.0	255.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1046	0	0.0	0	0.0
Forward	2	14356	643	23.0	1	26.0
Reverse	1	1078	0	0.0	0	0.0
Reverse	2	13193	545	21.3	1	25.0

CLEAR CREEK SEISMIC SURVEY

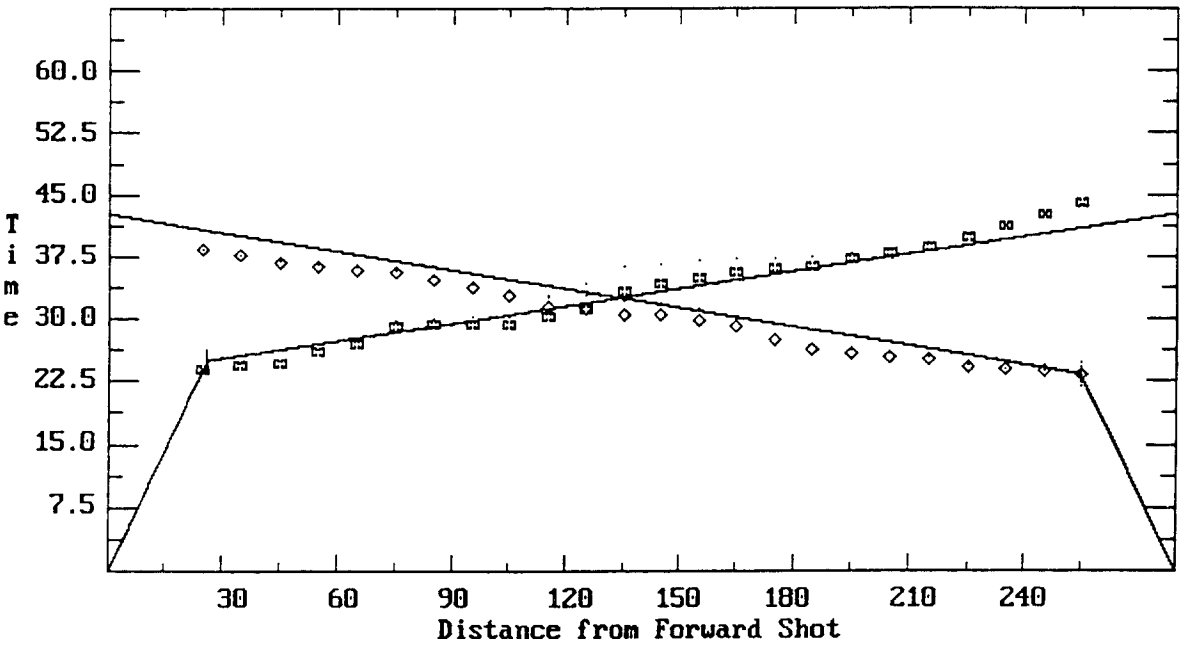
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS11002.TXE	CCS11005.TXE
Shot Pos:	-25.0	255.0

Time-Distance Plot for



CLEAR CREEK SEISMIC SURVEY

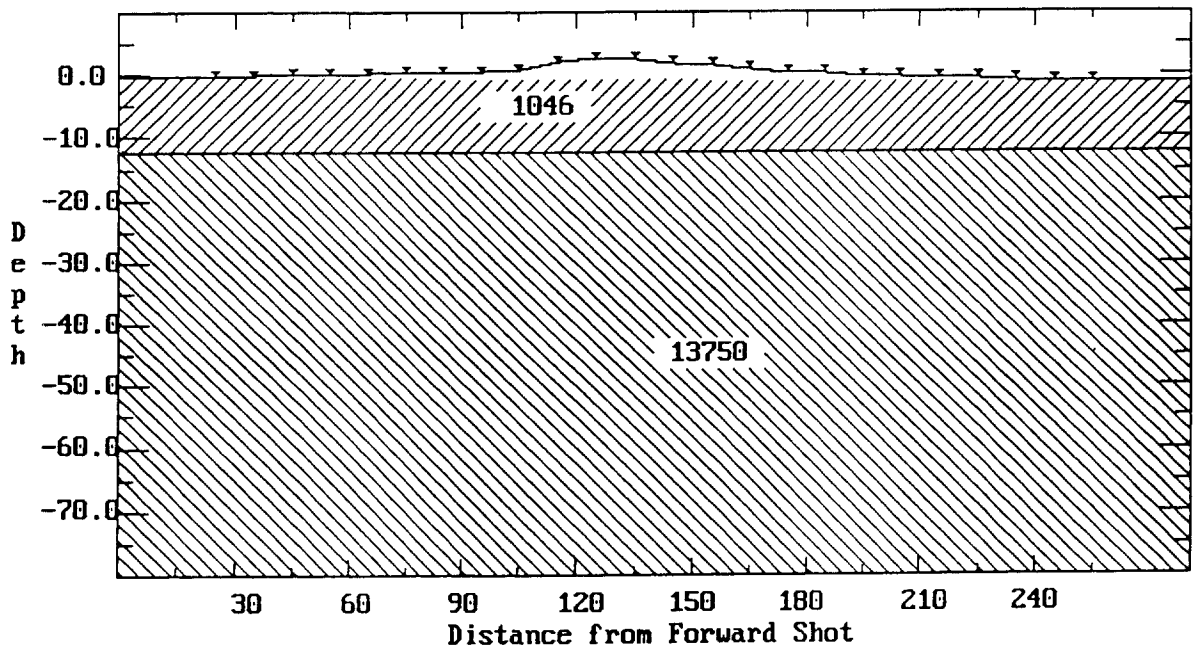
NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13

File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS11002.TXE	CCS11005.TXE
Shot Pos:	-25.0	255.0

Depth Profile Plot for



CLEAR CREEK SEISMIC SURVEY

NORTHERN DISTRICT DWR
BOB CONOVER
PROJECT GEOLOGY

18 Nov 97
REFRACT 3.13
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	1046	13750
Dip Angle:	-0.27	-0.35
Averaging Interval:	1- 279	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	565.3	12.1
1	25.0	565.2	12.0
2	35.0	565.2	12.0
3	45.0	565.3	12.1
4	55.0	565.4	12.3
5	65.0	565.5	12.4
6	75.0	565.6	12.5
7	85.0	565.7	12.6
8	95.0	565.8	12.7
9	105.0	565.9	12.8
10	115.0	567.2	14.1
11	125.0	568.0	15.0
12	135.0	567.7	14.7
13	145.0	567.2	14.2
14	155.0	566.8	13.8
15	165.0	566.4	13.4
16	175.0	565.8	12.8
17	185.0	565.6	12.6
18	195.0	565.2	12.3
19	205.0	565.0	12.1
20	215.0	564.8	11.9
21	225.0	564.6	11.7
22	235.0	564.4	11.5
23	245.0	564.2	11.3
24	255.0	564.0	11.1
Rev Shot	0.0	564.0	12.5

Saeltzer Dam Fish Passage Project
Seismic Refraction Line Data - CCSL 13

Phone Spacing: 10' Bearing: S 89 E

Geophone #	Distance (ft)	Geophone Elevation (ft)	Velocity 1 (ft/s)	Velocity 2 (ft/s)	Depth to Bedrock** (ft)	Bedrock Elevation (ft)
SP-25	-15	577.5	1342.0	16977.0	22.2	555.3
1	0	576.3	1342.0	16977.0	20.7	555.6
2	10	576.1	1342.0	16977.0	19.8	556.3
3	20	575.4	1342.0	16977.0	19.8	555.6
4	30	574.3	1342.0	16977.0	17.7	556.6
5	40	573.5	1342.0	16977.0	16.2	557.3
6	50	572.8	1342.0	16977.0	15.1	557.7
7	60	572.0	1342.0	16977.0	14.2	557.8
8	70	571.2	1342.0	16977.0	13.1	558.1
9	80	570.4	1342.0	16977.0	11.8	558.6
10	90	569.8	1342.0	16977.0	10.7	559.1
11	100	569.5	1342.0	16977.0	8.6	560.9
12	110	569.2	1342.0	16977.0	9.3	559.9
13	120	569.0	1342.0	16977.0	8.5	560.5
14	130	569.2	1342.0	16977.0	8.6	560.6
15	140	569.5	1342.0	16977.0	8.7	560.8
16	150	570.4	1342.0	16977.0	9.2	561.2
17	160	571.2	1342.0	16977.0	9.7	561.5
18	170	572.2	1342.0	16977.0	10.2	562.0
19	180	573.4	1342.0	16977.0	11.1	562.3
20	190	574.3	1342.0	16977.0	11.8	562.5
21	200	575.2	1342.0	16977.0	12.5	562.7
22	210	576.1	1342.0	16977.0	13	563.1
23	220	577.0	1342.0	16977.0	13.7	563.3
24	230	578.1	1342.0	16977.0	14.1	564.0
SP+25	255	580.5	1342.0	16977.0	13.6	566.9

rror factor +- 5 feet

CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCS13-2.TXE

Header data from file CCS13002.

File number:	CCSL13002
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0908971248
Operator note:	SHOT POINT -25', PHONE SPACING 10', LINE IN ROAD, COMPACT
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	-25.0
Shot location Y:	0.0
Shot location Z:	577.8

CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCS13-2.TXE

First Arrival and Elevation Data from CCS13-2.TXE

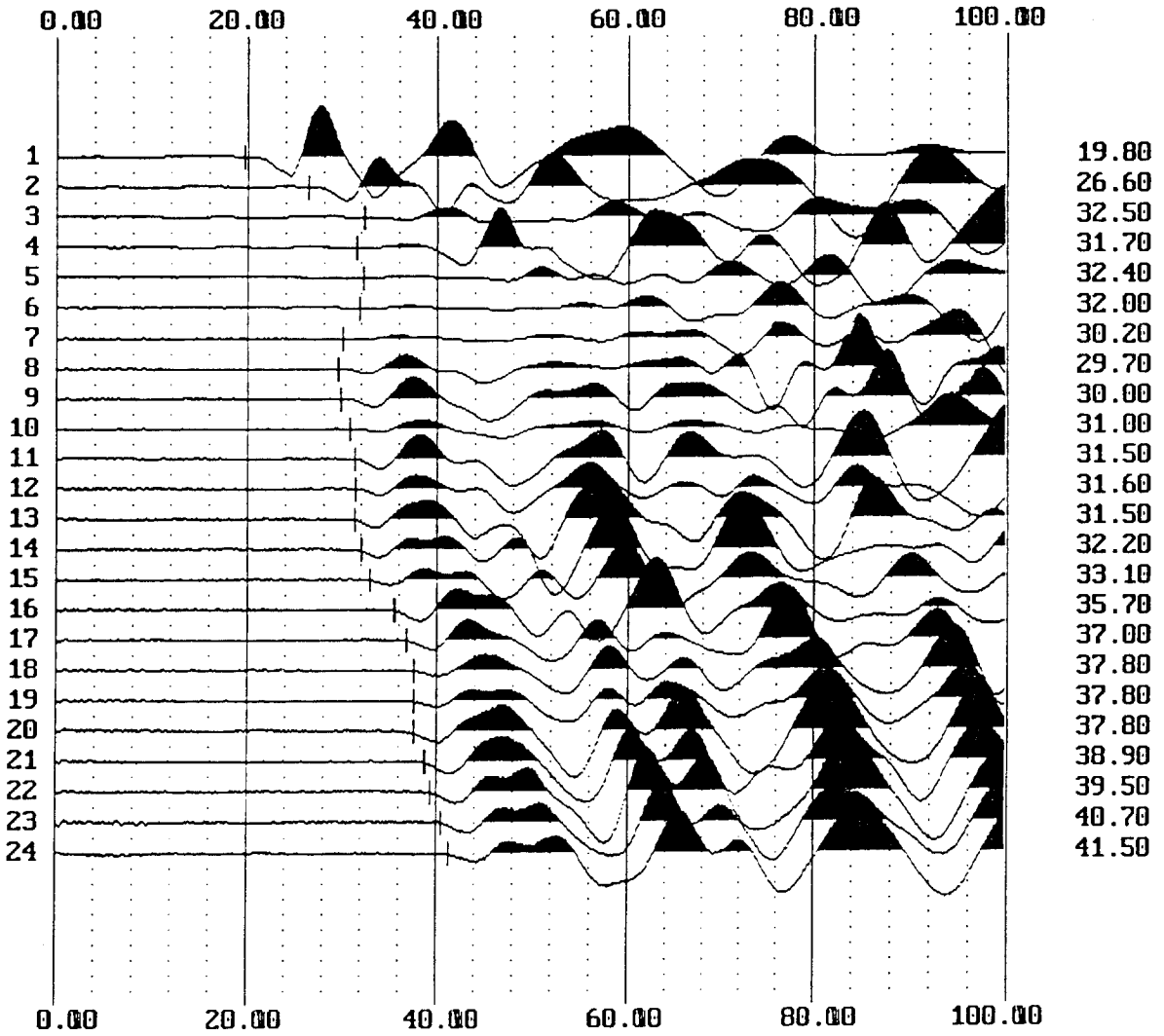
Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	577.80	-25.00	
1	577.00	0.00	19.80
2	576.40	10.00	26.60
3	575.80	20.00	32.50
4	575.00	(30.00)	31.70
5	573.80	(40.00)	32.40
6	573.00	(50.00)	32.00
7	572.40	(60.00)	30.20
8	571.60	(70.00)	29.70
9	570.60	(80.00)	30.00
10	569.80	(90.00)	31.00
11	568.00	(100.00)	31.50
12	569.00	(110.00)	31.60
13	568.60	(120.00)	31.50
14	569.00	(130.00)	32.20
15	569.40	(140.00)	33.10
16	570.20	(150.00)	35.70
17	571.00	(160.00)	37.00
18	571.80	(170.00)	37.80
19	573.00	(180.00)	37.80
20	574.00	(190.00)	37.80
21	575.00	(200.00)	38.90
22	575.80	(210.00)	39.50
23	576.80	(220.00)	40.70
24	577.60	(230.00)	41.50

CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.0
File: CCS13-2.TXL

Seismic waveform data from file CCS13002.



CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCS13-5.TXE

Header data from file CCS13005.

File number:	CCS13005
Job number:	CLEAR CREEK SEISMIC SURVEY
Date and time:	0908971257
Operator note:	SHOT POINT 255', PHONE SPACING 10'LINE IN ROAD
Manufacturer code:	BISON-2
Number of channels:	24
Samples / channel:	1000
Sample rate (ms):	0.10
Delay time (ms):	
High pass filter:	
Low pass filter:	
Notch filter:	
Shot location X:	255.0
Shot location Y:	0.0
Shot location Z:	580.2

CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCS13-5.TXE

First Arrival and Elevation Data from CCS13-5.TXE

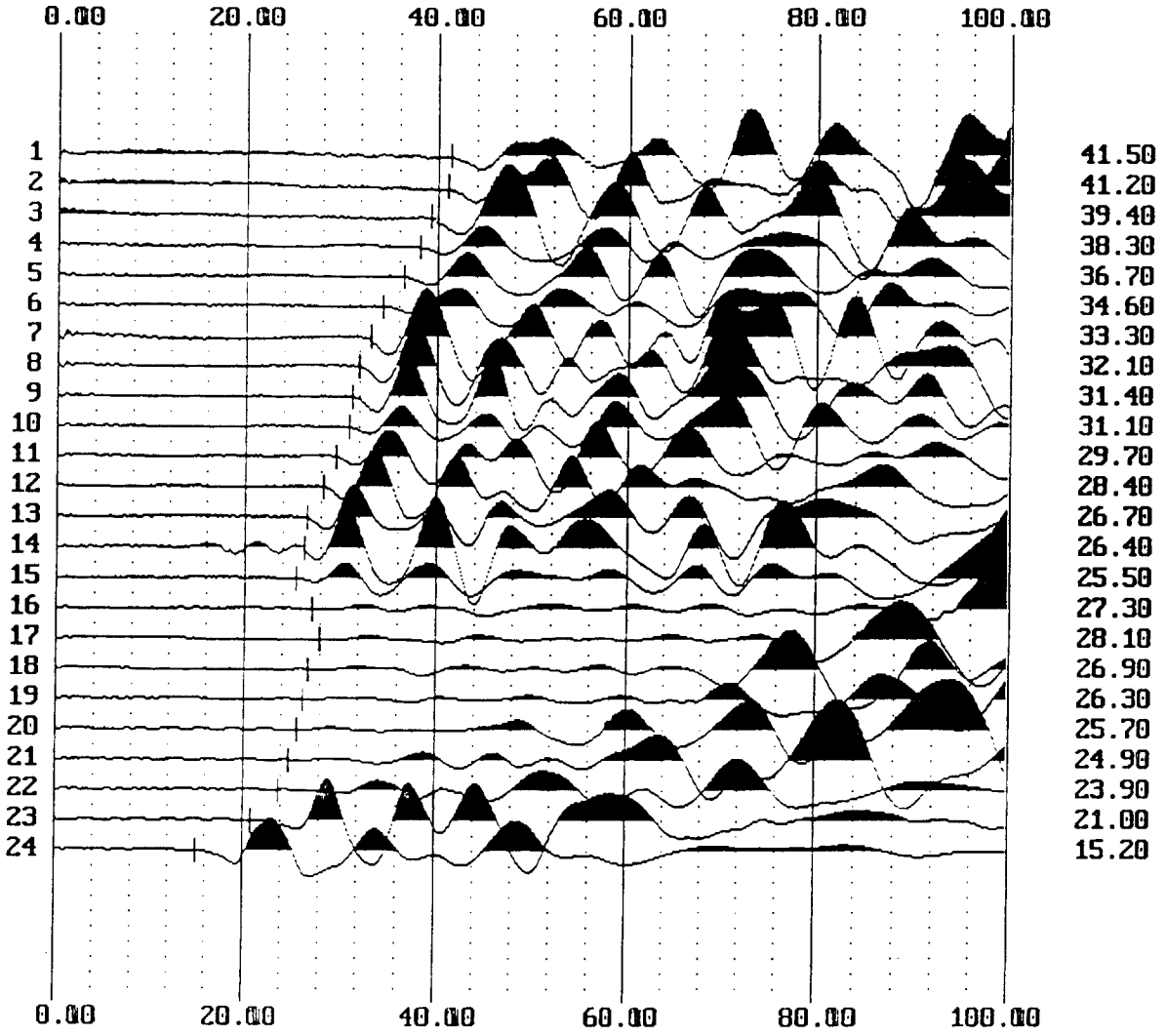
Geophone	Elevation (ft, m)	Position (ft, m)	First Arrival Time (msec)
(Shot)	580.20	255.00	
1	577.00	0.00	41.50
2	576.40	10.00	41.20
3	575.80	20.00	39.40
4	575.00	(30.00)	38.30
5	573.80	(40.00)	36.70
6	573.00	(50.00)	34.60
7	572.40	(60.00)	33.30
8	571.60	(70.00)	32.10
9	570.60	(80.00)	31.40
10	569.80	(90.00)	31.10
11	569.40	(100.00)	29.70
12	569.00	(110.00)	28.40
13	568.60	(120.00)	26.70
14	569.00	(130.00)	26.40
15	569.40	(140.00)	25.50
16	570.20	(150.00)	27.30
17	571.00	(160.00)	28.10
18	571.80	(170.00)	26.90
19	573.00	(180.00)	26.30
20	574.00	(190.00)	25.70
21	575.00	(200.00)	24.90
22	575.80	(210.00)	23.90
23	576.80	(220.00)	21.00
24	577.60	(230.00)	15.20

CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File: CCS13-5.TXE

Seismic waveform data from file CCS13005.



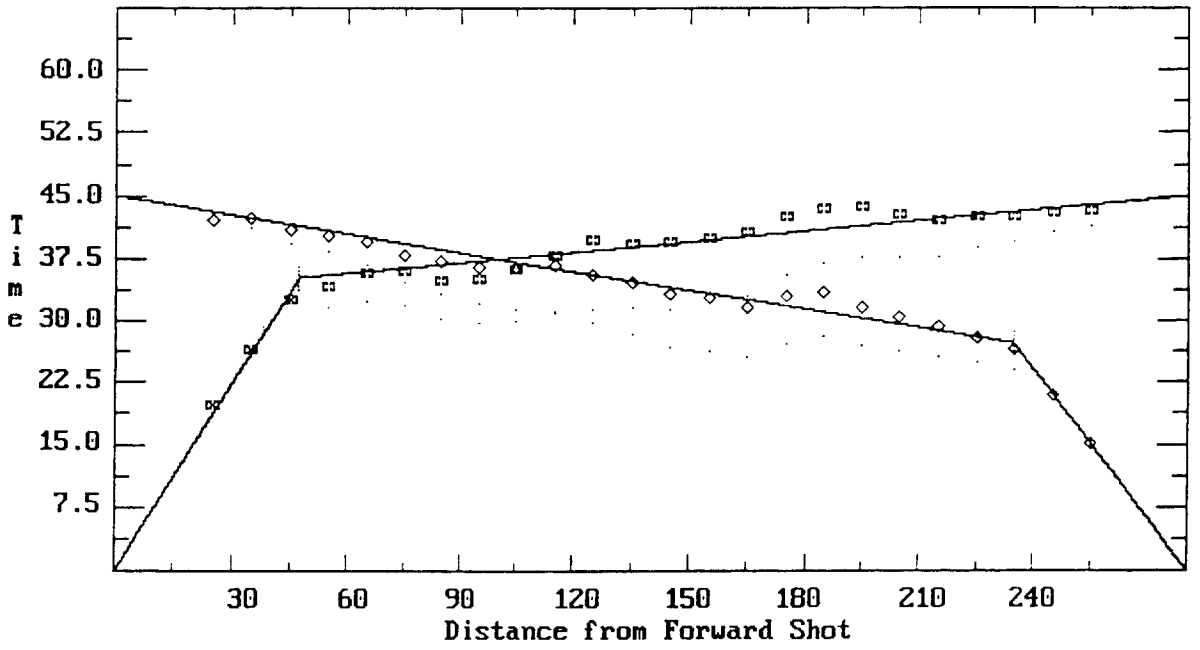
CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.0
File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS13-2.TXE	CCS13-5.TXE
Shot Pos:	-25.0	255.0

Time-Distance Plot for



CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS13-2.TXE	CCS13-5.TXE
Shot Pos:	-25.0	255.0

Time-Distance Line Fit Summary for

Direction	Layer	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
Forward	1	1342	75	0.0	1	0.0
Forward	2	23675	>E3	33.0	0	47.0
Reverse	1	1659	113	0.0	1	0.0
Reverse	2	13239	458	23.7	0	45.0

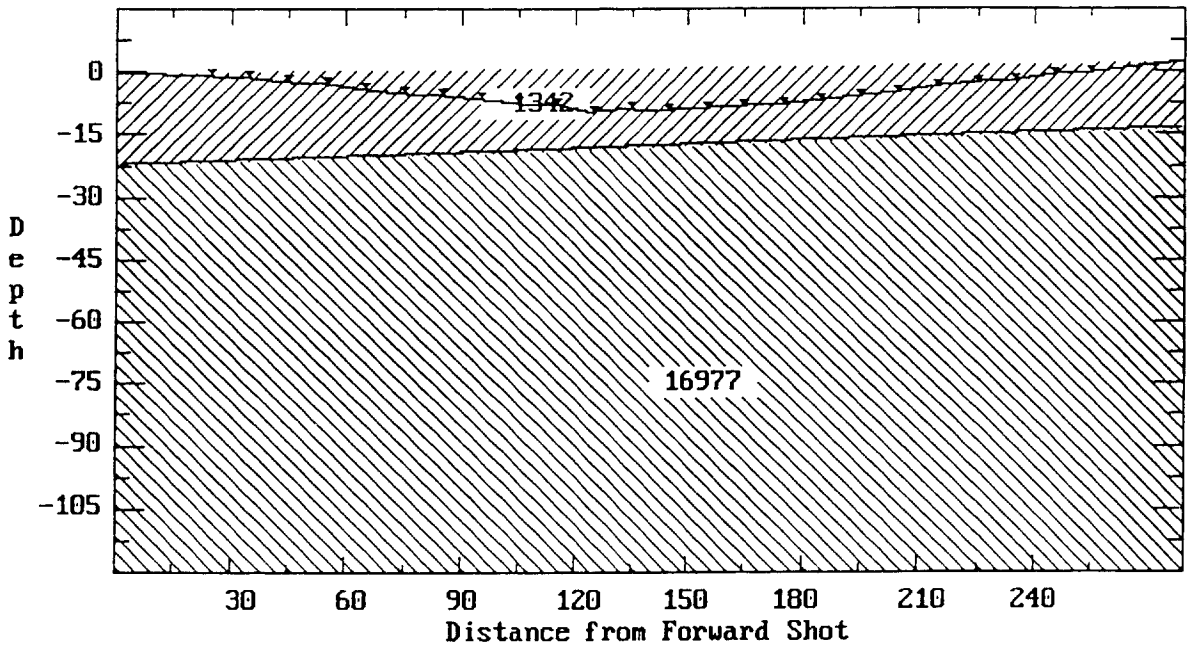
CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File:
Number of Layers: 2
Reduction Velocity: 0.0

TXE files:	Forward	Reverse
	CCS13-2.TXE	CCS13-5.TXE
Shot Pos:	-25.0	255.0

Depth Profile Plot for



CLEAR CREEK SEISMIC STUDY,

PIPELINE ALIGNMENT
SEISMIC LINE CHRSL-13
PROJECT GEOLOGY

10 Sep 97
REFRACT 3.09
File:

Depth Profile Summary for

	Layer 1	Layer 2
Velocity:	1342	16977
Dip Angle:	0.49	2.27
Averaging Interval:	2- 279	

Geophone	Distance from Forward Shot	Elevation	Depth from Surface
Fwd Shot	0.0	577.8	22.2
1	25.0	577.0	20.7
2	35.0	576.4	19.8
3	45.0	575.8	18.8
4	55.0	575.0	17.7
5	65.0	573.8	16.2
6	75.0	573.0	15.1
7	85.0	572.4	14.2
8	95.0	571.6	13.1
9	105.0	570.6	11.8
10	115.0	569.8	10.7
11	125.0	568.0	8.6
12	135.0	569.0	9.3
13	145.0	568.6	8.5
14	155.0	569.0	8.6
15	165.0	569.4	8.7
16	175.0	570.2	9.2
17	185.0	571.0	9.7
18	195.0	571.8	10.2
19	205.0	573.0	11.1
20	215.0	574.0	11.8
21	225.0	575.0	12.5
22	235.0	575.8	13.0
23	245.0	576.8	13.7
24	255.0	577.6	14.1
Rev Shot	0.0	580.2	13.6

APPENDIX C
PHOTOGRAPHS

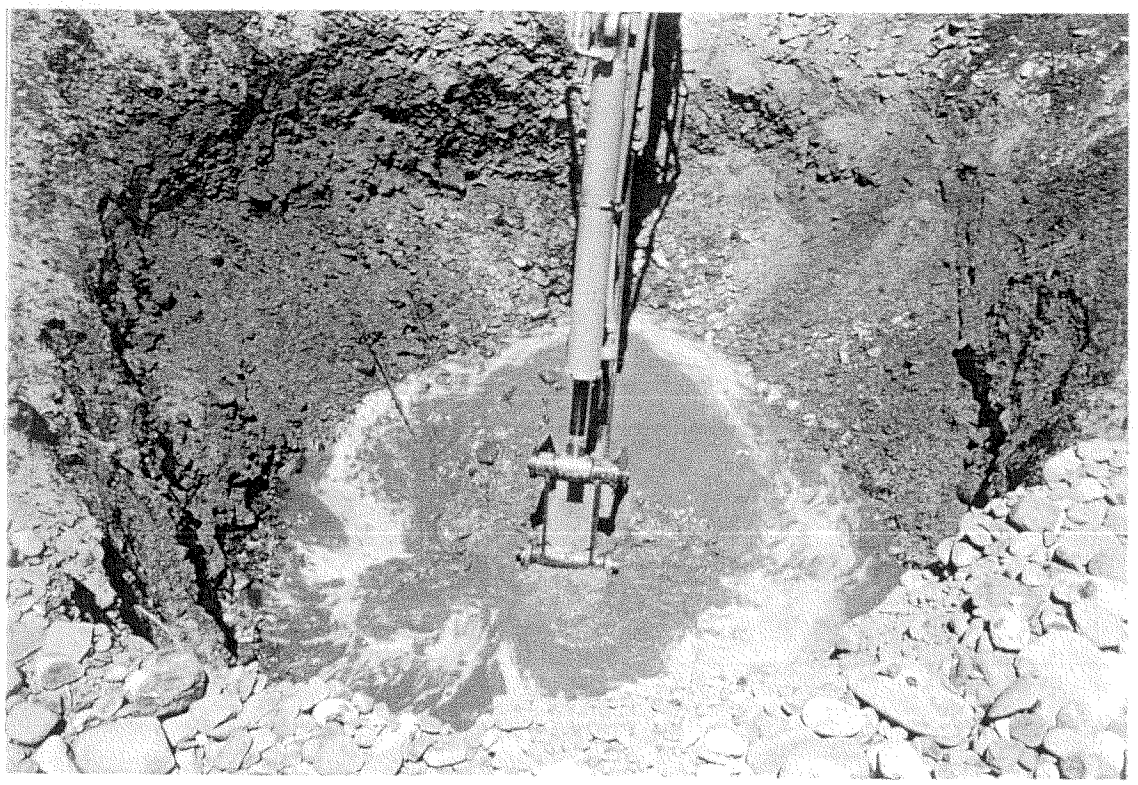


Photo 1 – Excavation of Test Pit 3. Note poorly graded gravel with sand and cobbles along pit walls.

Photo 2 – Test Pit 3, looking west. Note the depth to water in the pit and the nearby standing water.

Photo 3 – Excavation of Test Pit 2. Note pavement of gravel and cobbles covering Clear Creek stream channel deposits. View is to the east.

Photo 4 – Test Pit 2. Note the poorly graded gravel with sand and cobbles in the excavation. Test Pit 2 is located near the center of the proposed dam axis.

Photo 5 – Spoil from Test Pit 1. Note the abundance of rounded to sub-rounded cobbles.

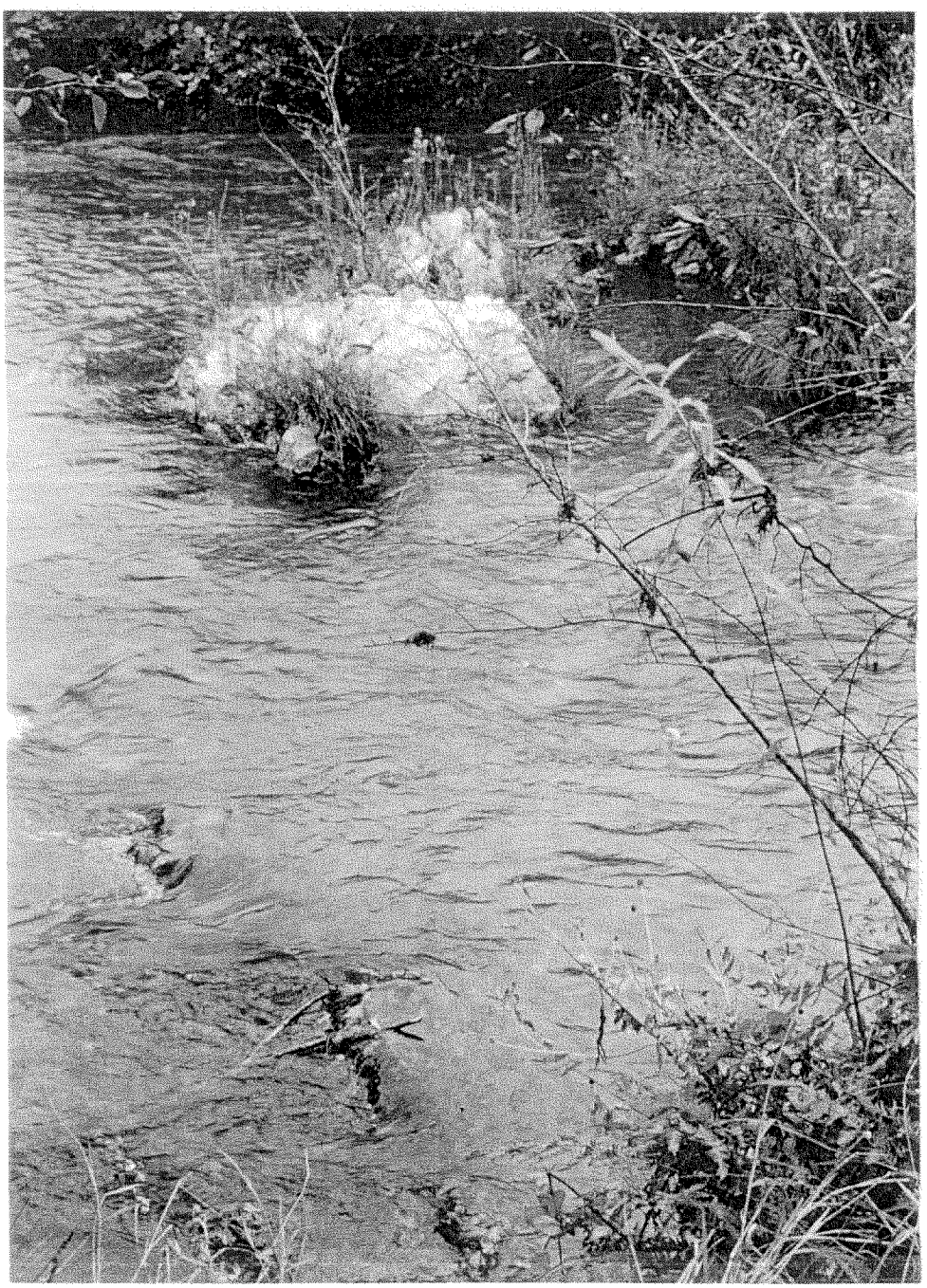


Photo 6 – Outcrop #1, within the active channel of Clear Creek. Note that bedrock lies within the center of the stream channel and in the foreground. View is to the south from the north bank of Clear Creek.

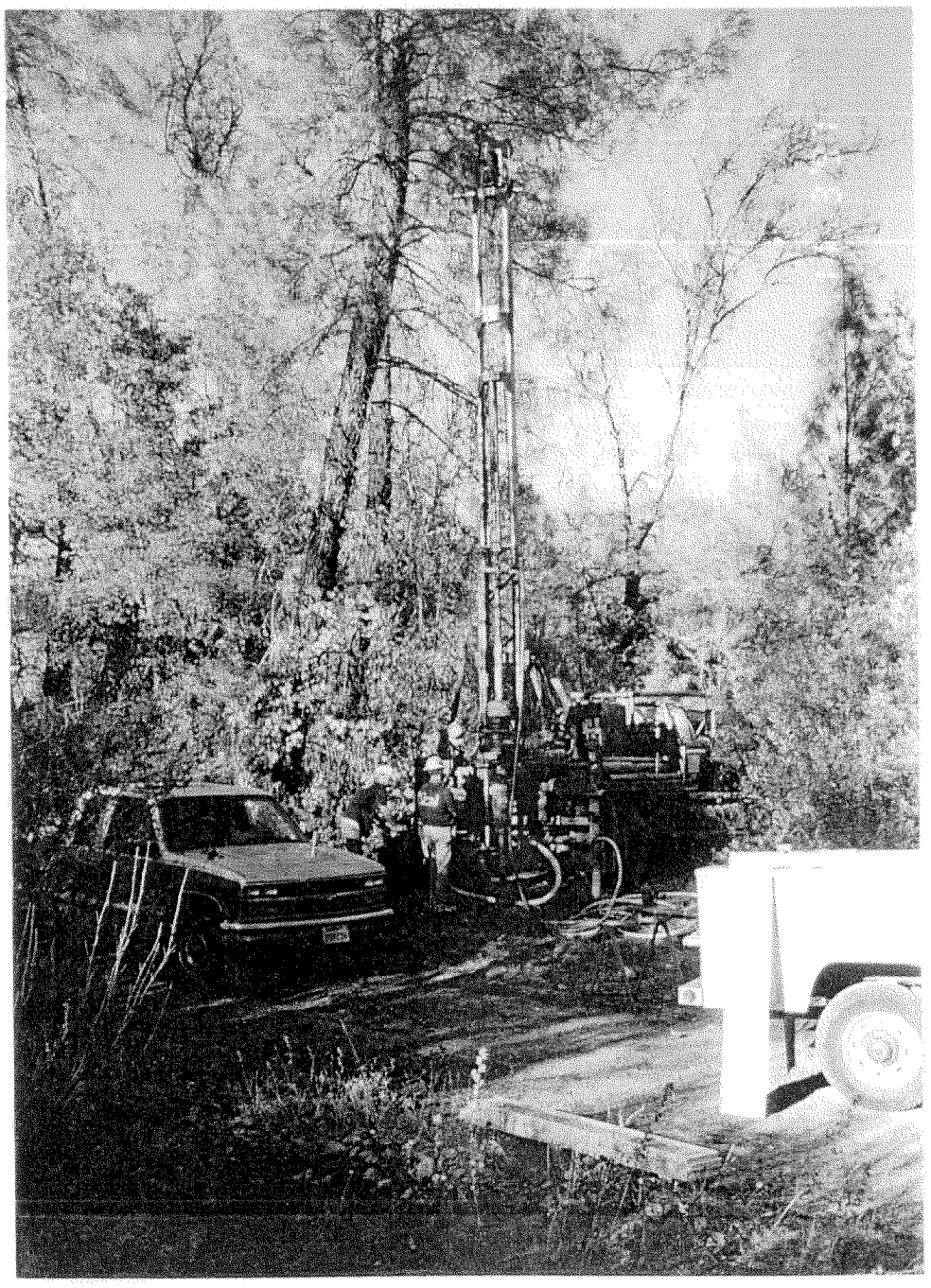


Photo 7 – Drill rig set up on and drilling boring CCB-7A. Most borings were advanced using hollow-stem augering and diamond bit core drilling.

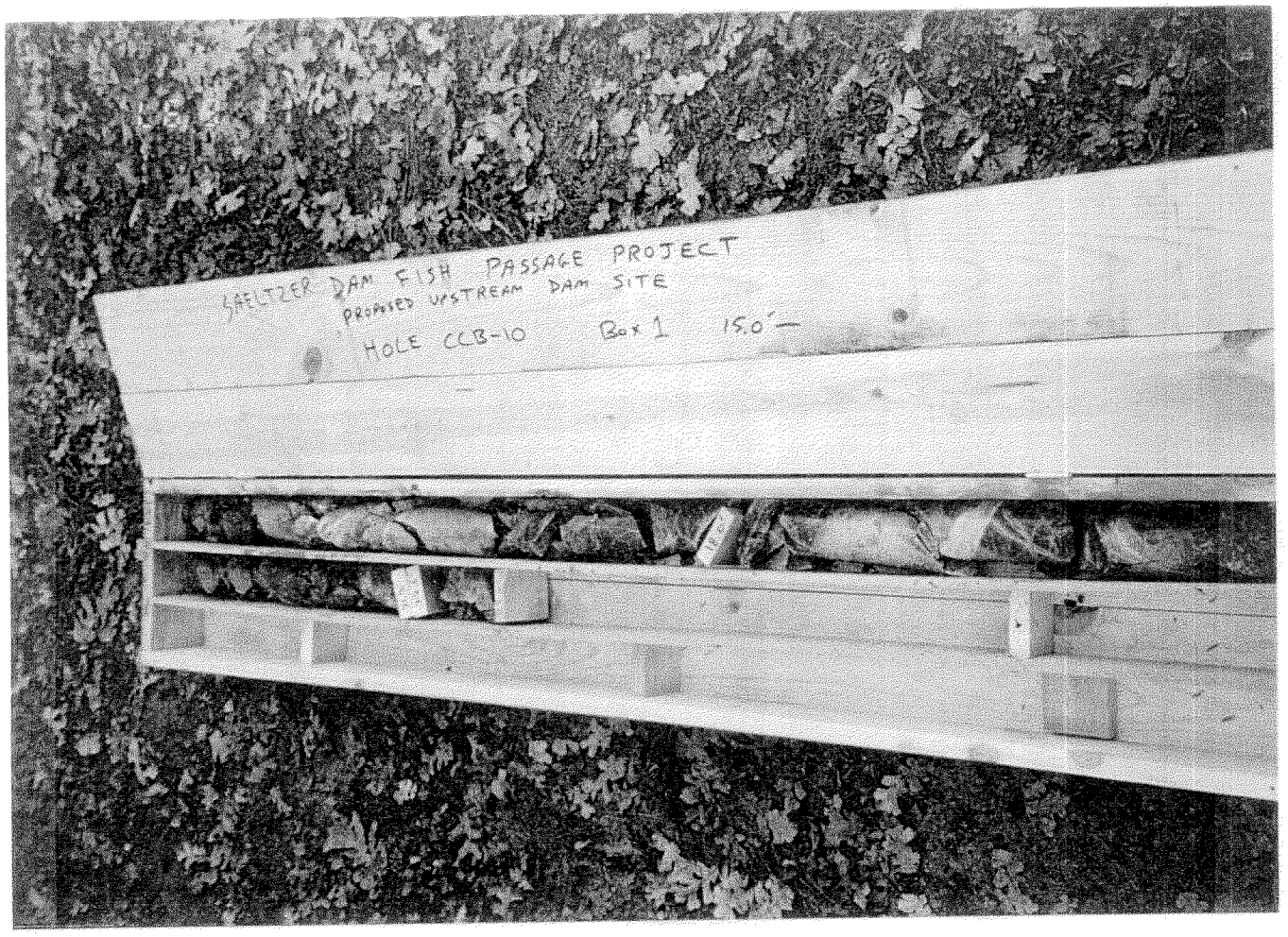


Photo 8 – Rock core from boring CCB-10, 15 to 23 feet below ground surface. The Copley Greenstone (Dcgs) pictured is representative of bedrock at the site.